**PART – I(COMMERCIAL)**

**Bharat Coking Coal Limited**

**Office of the General Manager (CMC)**

**Koyla Bhawan, Koyla Nagar, Dhanbad 826005**

Name of Work : Planning, Design, Engineering, Construction, Fabrication, Supply, Erection, Trial-run, Commissioning and Testing of Coal Handling Plant 5.0 Mtpa capacity with loading arrangement through Silo consisting of all Civil, Structural, Electrical and Mechanical Works and all other accessories and facilities required to make it complete in all respects, along with approach road on turnkey basis.

2. Place of Work : Opposite to existing siding at MAHESHPUR within the surface limit of proposed Block III OCP on the connecting link between main line & existing Borora siding district Dhanbad (Jharkhand)


4. Earnest Money : Rs. 50,00,000/- Only

5. Date & Time of submission of tender (i.e. Part-I, Part-II & Part-III) : On 06.04.2010 upto 15.30 hrs. (IST)

6. Date & Time of Opening of Part-I & Part-II Tender : 16.00 hrs. IST on 08.04.2010

7. Date & Time of opening of Price bid (Part-III) : Shall be communicated in due course after evaluation of Part-I tender.

8. Date of Issue of Tender Document : 

9. Money Receipt No. towards cost of Tender Document : 

TO

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General Manager (CMC)
1. IMPORTANT

The tenderer is requested to go through the complete tender document and understand the requirements for submission of credentials & required documents before the same are enclosed with their tender offer.

The tenderer must check “Check List” given in the tender document before submission of their tender offer.

INCOMPLETE AND/ OR INCORRECT INFORMATION / CREDENTIALS / DOCUMENTS / TENDER OFFER IS LIABLE FOR REJECTION.

Guidance for submission of credentials / documents along with offer (Must be checked / verified by the tenderer before submission of offer):

1. Completion certificate for similar nature of works---

   A. The certificate(s) of work should contain: -
      
      • Name of work (Similar nature of work as mentioned in the NIT) [Not only the Agt / WO ref.].
      • Work order / Agreement No/LOI.
      • Award Value (As per work order / agreement)
      • Date of commencement & Completion as per work order / Agreement.
      • Actual Date of commencement & Completion.
      • Completed / executed value of work.
      • Status of work (Successfully completed or in progress). For work in progress, the value of work executed on date successfully.
      • Seal / Designation/Official address of certificate issuing officer.
B. **Copy of work order** to be submitted in support of corresponding certificate(s) along with the copy of Bill of quantity/Copy of bills (for verifying similar nature of works).

2. **Certificate for Annual financial turnover** certified by Charted Accountant or copy of yearly audited reports including balance sheet and profit & loss account for the prescribed periods to be submitted.

3. **Bid Capacity**:

   - Maximum value of **Civil Engineering Works** executed in any one year during the last five years (updated to present level @ 5% per calendar year) taking into account the completed as well as works in progress are to be furnished duly signed by the bidder.

   **NOTE**: Maximum value of Civil Engineering Works as per above is to be submitted separately, (not the audited reports only) for calculation of Bid Capacity.

   - The informations as asked for in a tabular form in respect of –

     (A) Existing commitments and on going works.
     (B) Works for which bids already submitted.
     (C) Works performed as prime contractor (In the same name) for works of a similar nature, over the last five years.

     are essentially to be furnished by the bidder.

4. Affidavit / Bank Guarantees must be in the prescribed format of the Tender Document.

5. List of Technical persons and Tools & Plants to be furnished by the tenderer.
6. Status of company i.e. Proprietary firm / Partnership firm / Pvt. Ltd Company / Ltd Company/ PSU / Joint ventures are to be given as prescribed in the Tender Document

7. Income Tax Permanent Account Number (PAN)

Particulars of Registration with appropriate Sales Tax Authorities (In relation with ‘Works Contract Tax’) if applicable.

8. Particulars of Service Tax Registration, if Service Tax is applicable

9. Particulars of Registration / Clearance from the Appropriate Provident Fund Authorities, if applicable

Above information / documents / credentials are required to be duly signed by the bidder.

For further clarifications, if any, the tenderer may contact the office of General Manager (CMC) BCCL Koyla Bhawan, Dhanbad

I / we hereby declare that the above instructions have been gone through by me/ us along with the other provisions hereinafter given in the document and I / we have given all the documents along with the Part–I tender offer accordingly.

Signature of Tenderer
2. CHECK LIST OF DOCUMENT TO BE SUBMITTED BY THE TENDERERS ALONG WITH PART -I

(1) Firm’s registration details, if any.

(2) Income Tax Permanent Account Number (PAN)

(3) Particulars of Registration with appropriate Sales Tax Authorities (In relation with ‘Works Contract Tax’) if applicable.

(4) Particulars of Service Tax Registration, if Service Tax is applicable.

(5) Particulars of Registration / Clearance from the Appropriate Provident Fund Authorities, if applicable

(6) Details of Construction Equipment to be possessed by the tenderers and the list of Technical person working under them.
(7) Tenderers must submit the proof of Credentials for qualifying criteria.

(8) Affidavit on non-judicial stamp paper in support of authenticity of credentials.

(9) Information of Bid capacity, if applicable.

(10) **STATUS OF THE FIRM** : Copy of the following as applicable should be enclosed to Indicate the status of the firm

(1) Registered Partnership deed
(2) Power of attorney
(3) Affidavit in case of proprietorship firm
(4) Articles of Association/Memorandum

(11) **DECLARATIONS**: - Stating the firm is not banned or de-listed by any Govt. Or Quasi Govt. Agencies or PSUs. If this declaration is not given the bid will be rejected as non-responsive.

(12) Power of Attorney, if any.

(13) **CERTIFICATE**: Only for tenderers using downloaded tender document from Website.
13. CERTIFICATE

(Only for tenderer using downloaded tender document from Website)

1. We undertake that the tender submitted by, is downloaded from BCCL website (http://www.bccl.cmpdi.co.in) and is same in content and form (verbatim), and any deviation, if detected, at any state, would entitle BCCL to reject our bidding/offer without assigning any reason or recourse to any penal action and would be legally binding on us.

2. We undertake, we will accept the tender document as available in web site and our tender will be rejected if any tempering in the tender document is found to be done at time of opening of tender.

3. In case of any discrepancy between the tender document downloaded from web site & the master copy available in the office, the later shall prevail and will be binding on us. We will not claim on this account.

Signature:________________________________________

(Of tenderer)

Seal:________________________________________
NOTE: - All the above documents which are to be submitted along with Part – I of the tender should be attested by any Gazetted officer of Govt. (Central or State)/Notary and the same should be certified/signed by the tenderers also.

I / We hereby certify that I / We have gone through the above instructions and submitted all the documents accordingly.

Signature of the Tenderer/s
TENDER DOCUMENT
FOR
DESIGN, SUPPLY, ERECTION, COMMISSIONING
AND TESTING
OF
COAL HANDLING PLANT WITH
SILO LOADING ARRANGEMENT
NEAR
MAHESHPUR SIDING (5.0 Mtpa)
AT
BHARAT COKING COAL LIMITED, DHANBAD

PART - I : COMMERCIAL PART

Bharat Coking Coal Ltd.
(A Subsidiary of Coal India Ltd.)
Koyla Bhawan Complex, Dhanbad- 826005 (Jharkhand)
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## PART– I : COMMERCIAL

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SECTION -1

TENDER NOTICE
BHARTH COKING COAL LIMITED
(A Subsidiary of Coal India Limited)
Koyla Bhawan Complex, Dhanbad-826005
Jharkhand, India.

TENDER NOTICE

TENDER NOTICE NO. : BCCL / TENDER/GM(CMC)/F-SILO/2009/1666
DATE: 06.11.09

1. BHART COKING COAL LIMITED (BCCL), Koyla Bhawan, Dhanbad, Jharkhand, invites sealed turnkey bids under three parts/envelopes system from reputed and experienced contractors for the following works:

Brief Scope of Work:

<table>
<thead>
<tr>
<th>Name &amp; Description of Works</th>
<th>Location</th>
<th>Period of completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning, Design, Engineering, Construction, Fabrication, Supply, Erection, Trial-run, Commissioning and Testing of Coal Handling Plant 5.0 Mtpa capacity with loading arrangement through Silo consisting of all Civil, Structural, Electrical and Mechanical Works and all other accessories and facilities required to make it complete in all respects, along with approach road on turnkey basis.</td>
<td>Opposite to existing siding at MAHESHPUR within the surface limit of proposed Block III OCP on the connecting link between main line &amp; existing Borora siding district Dhanbad (Jharkhand).</td>
<td>36 months</td>
</tr>
</tbody>
</table>

2. The total scope of supply and works & services shall be treated as a combined contract as whole.

3. Earnest Money / Bid Security of Rs.50.00 lakhs (Fifty lacs only) is to be deposited in the form of irrevocable Bank Guarantee (from any Scheduled Bank payable at its branches at Dhanbad/Kolkata) with validity 28 days beyond the validity of the Bid in the format given in the Bid Document in a separate envelope alongwith the tender. Certified Cheques and Demand Drafts will also be acceptable as Earnest Money/Bid Security drawn in favour of Bharat Coking Coal Limited on any scheduled Bank payable at its branch at Dhanbad. Earnest Money/Bid Security of the unsuccessful bidder shall be refunded as promptly as possible after opening of Price Bid and finalisation of the tender and shall bear no interest.
4 Application Fee for Tender Documents: The price of Tender Documents shall be Rs.10000/- (Rupees Ten thousand only) payable either in cash or by Bank Draft drawn in favor of Bharat Coking Coal limited, Dhanbad on SBI payable at its branch at BCCL Township, Dhanbad.

5. Availability of tender documents: Tender documents including terms and conditions of works, shall be available on payment, from the following office, during the period (during the working hours) as stated below.

<table>
<thead>
<tr>
<th>Place</th>
<th>DATE &amp; TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) Office of the</td>
<td>From 02.12.2009 to 04.01.2010</td>
</tr>
<tr>
<td>General Manager (CMC)</td>
<td>From 10:30 hours (IST) to 16.00 hours IST</td>
</tr>
<tr>
<td>BCCL, Koyla Bhawan Complex</td>
<td></td>
</tr>
<tr>
<td>Dhanbad-826005</td>
<td></td>
</tr>
<tr>
<td>(5th Level)</td>
<td></td>
</tr>
<tr>
<td>ii) Office of Chief Sales Manager,</td>
<td>-do-</td>
</tr>
<tr>
<td>BCCL</td>
<td></td>
</tr>
<tr>
<td>6, Lyons Range Kolkata-700001, India</td>
<td></td>
</tr>
</tbody>
</table>

Tender Documents are also available on our website. For details please visit company’s website at [http://bccl.cmpdi.co.in/](http://bccl.cmpdi.co.in/)

6. General Instructions for Submission of Tender: A tenderer should strictly be complied with the following instructions:

(a) A tenderer is required to submit offers in sealed covers giving reference to this Tender Notice No. and date, containing offers in three parts prominently superscribing as Part I, Part II and Part III respectively.

(b) Three Parts of the bid should contain the details as follows:

Part-I - Full details of the firm, information on the supplies of similar equipment to different parties in the country, details of project handled, testimonials and documentary evidence in support of satisfactory performance, financial capabilities and any other relevant information and the Earnest Money Deposit.

Part-II - (i) Technical offer along with technical specifications of equipment/know–how offered, drawings, pamphlet etc. strictly in terms of tender enquiry.

Part–III-Prices only in the format as indicated in the tender document.
The Earnest Money Deposit is to be submitted in a separate envelope altogether; super-scribing “Earnest Money Deposit”; and not inside the envelope containing Part I or part II of the Bid.

The bidders, who will download the tender documents from the website of the company, will be required to pay the cost of tender documents (Application Fee) by Bank Draft as per NIT at the time of submission of tenders.

The bidders will be required to submit an undertaking that they will accept the tender documents as available in the website and their tender shall be rejected if any tampering in the tender document is found to be done at the time of opening of tender. The Bank Draft towards the cost of tender documents (Application Fee) and the undertaking of the tenderer as above shall be submitted in a separate envelope marked “Cost of Tender Document and the Undertaking” and not with Part-I/ EMD.

In case of any discrepancy between the tender documents downloaded from the web site and the master copy available in the office, the latter shall prevail and will be binding on the tenderers. No claim on this account will be entertained.

Part-II and III of the offer shall be opened only in respect of such tenders as are found valid after scrutiny of Part-I.

7. **Validity of offer**: The rates offered in Part-III shall be valid for 180 (one hundred and eighty) days from the date of opening of part-I of the tender.

8. **PRE-BID MEETING**

A pre bid meeting will be held on 03.02.2010 with intending tenderers at Conference Room, Office of Director(T)OP, Level-IV, Koyla Bhawan, BCCL at 11.00 AM.

9. **Receipt of Tenders**: Tenders are to be received in sealed covers upto 15:30 hours (IST) on 06.04.2010 at the following office:Office of the General Manager (CMC), Level-V, BCCL, Koyla Bhawan Complex,
Dhanbad – 826005 (India) and also in the office of Chief Sales Manager BCCL 6, Lyons Range, Kolkata-700001 (India).

10. **Opening of Tenders**: Tenders will be opened at 16:00 hours (IST) on 08.04.2010 in the office of the General Manager (CMC), Level-V, BCCL, Koyla Bhawan Complex, Dhanbad-826005 (India).

11. After opening of the tender, if the company decides to negotiate, the tenderers should be in a position to present himself or depute their authorised representatives, at short notice, with full authority for negotiating on technical as well as commercial terms and conditions of the contract.

12. The Company is not under any obligation to accept the lowest tender(s) and reserves the right to reject any or all the tenders without assigning any reason whatsoever and also to distribute the works and allot it to more than one tenderer, at its sole discretion.

13. **Purchase Preference**: Purchase preference would be applicable to Indian CPSEs if applicable.

14. **Eligibility criteria for the Bidders**

The intending bidder must have in its name as a prime contractor experience of having successfully completed similar works during last 7 (seven) years ending last day of month previous to the one in which bid applications are invited should be either of the following:

(a) Three similar completed works each costing not less than the amount of Rs. 41.60 Crores

Or

(b) Two similar completed works each costing not less than the amount of Rs. 52.00 Crores.

Or

One similar completed work costing not less than the amount of Rs. 83.20 Crores.

**Similar work means** - Work related to planning, design, supply, construction and commissioning of Coal handling / Bulk material handling plant/system consisting of crushers, feeders, with RCC bunker or Track hopper or Silo with belt conveyors system on turnkey basis.

(b) **Average annual financial turnover of work during the last 3(three) years**, ending 31st March of the previous financial year should be at least Rs. 31.20 Crores.

(c) **Evidence of possessing adequate working capital of at least Rs. 20.80 Crores.** inclusive of access to lines of credit and availability of other financial resources to meet the requirement.
Other details are available in bid document.

15. The bidders are required to sign the Integrity Pact as per format given in Tender Document Part-I.

Name and address of Independent External Monitor:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Shri D. Bandopadhyay, IAS(Retd.)</td>
<td>GD-89, Sector-III, Salt Lake, Kolkata-700016</td>
</tr>
</tbody>
</table>

Sd/-
General Manager (CMC), BCCL,
Koyla Bhawan Complex, Dhanbad-826005(India)

CC :- Shri D. Bandopadhyay, IAS(Retd.), GD-89, Sector-III, Salt Lake, Kolkata-700016
CC:-PRO – With a request to publish the abridged NIT as enclosed in local as well as National dailies as per norms of the Company and also arrange to send the paper cutting to the Contract Management Cell.
CC: D(P)/ D(T)OP/ D(T)P&/D(F)/ CVO.
CC: CGM(Cordn)/CGM(S&M)/GM(Exc)/GM(P&P)/CGM(M&M)/CGM(Finance)/GM(E&M)/GM(IE)/R.D., RI-II, CMPDI
CC: GM(System) - with a request to display this NIT in BCCL Website. The downloading facilities should be available during the period of sale of Tender document only.
CC: Sr.ES to CMD for kind information of CMD.
CC: HOD (Admin) with a request to display this NIT in Koyla Bhawan Notice Boards.
CC: All CGMs/GMs in the Areas including Washery Division for wide circulation through display in the Notice Boards.
CC: Inspector, CISF- with a request to deploy security personnel at the office of GM(CMC), Level-V Koyla Bhawan on 06.04.2010 from 9.30A.M to 4.00P.M and on 08.04.2010 from 3.30 PM till completion of the meeting.
CC: Chief Sales Manager, Sales & Marketing Deptt.,BCCL, 6,Lyons Range, Kolkata.
CC: CGM (Production), CIL, Kolkata.
CC: Kolkata offices of all Subsidiaries.
CC: CGM/GM(Contract Management Cell),WCL/SECL/NCL/MCL/ECL/CCL.

General Manager
(Contract Management cell)
SECTION -2

INSTRUCTIONS TO BIDDERS
SECTION-2

INSTRUCTIONS TO BIDDERS

1. SCOPE OF TENDERER

1.1 Bharat Coking Coal Limited, Dhanbad P.O. BCCL Township, Dist. Dhanbad, Jharkhand, India (referred to as Employer/ Owner/ Company in these documents) invites bids for the construction on turnkey basis for the works (as defined in these documents and referred to as "the works") detailed in the table given in the Notice Inviting Tenders (NIT). The tenderers must submit tenders for all of the works (Packages or slices) detailed in the NIT.

1.2 The successful Bidder will be expected to complete the Works by the Intended Completion date specified in the Contract.

1.3 The total scope of supply and works & services shall be treated as a combined contract as a whole.

2. ELIGIBLE TENDERERS:

2.1 The invitation for bids is open to all bidders eligible to participate as per qualifying criteria laid down separately hereinafter.

2.2 All bidders shall provide in Part-I, Forms of Bid and Qualification Information, a statement that the Bidder (including all members of a joint venture and sub contractors) is not associated, nor has been associated in the past, directly or indirectly, with the consultant or any other entity that has prepared the design, specifications, and other documents for the Project or being proposed as Engineer for the Contract. A firm that has been engaged by the Employer to provide consulting services for the preparation or supervision of the Works shall not be eligible to Bid.

2.3 Joint Venture: Two or three companies/ contractors may jointly undertake contract(s). Each entity will be jointly responsible for completing the task as per the contract.

2.4 The company reserves its right to allow Public Enterprises purchase preference facility as admissible under prevailing policy.

3.0 QUALIFICATION OF THE TENDERER:

3.1 All bidders shall provide in Part-I, Forms of Bid and Qualification Information, a preliminary description of the proposed work method and schedule, including drawings and charts, as necessary.
3.2 In the event that prequalification of potential bidders has been undertaken, only Bids from pre-qualified bidders will be considered for award of Contract. These qualified bidders should submit with their Bids any information updating their original prequalification applications or, alternatively, confirm in their Bids that the originally submitted prequalification information remains essentially correct as of the date of Bid submission. The update or confirmation should be provided in Part-I.

3.3 If the Employer has not undertaken prequalification of potential bidders, all bidders shall include the following information and documents with their bids (copies of all documentary evidences are to be duly authenticated by the tenderers/ constituted attorney of the tenderer with full signature and seal.

All signed declarations are to be made in the tenderer’s letter head.)

(a) Copies of original documents, defining the constitution or legal status, place of registration, and principal place of business; written power of attorney of signatory of the Bid to commit the Bidder;

(b) i) total monetary value of contractual work performed for each of the last five years.

ii) experience of having successfully executed similar works during last seven years;

(c) experience in works of similar nature and size for each of the last five years and details of work under way or contractually committed; and the name and address of clients who may be contacted for further information on those contracts with performance certificate for the works executed in last five years from the respective owners;

d) major items of construction equipment proposed to carry out the contract;

e) qualifications and experience of key site management and technical personnel proposed for the Contract;

f) reports on financial standing of Bidder, such as profit and loss statement and auditor’s reports for the past five years;

g) evidence of adequacy of working capital for this Contract (access to lines of credit and availability of other financial resources);

h) authority to seek references from the Bidder's bankers;

i) information regarding any litigation, current or during the last five years, in which the Bidder is involved, the parties concerned and disput amount including status of final settlement of contracts including claims/counter claims, liquidated damages, bonus etc., if any;

j) proposals for sub contracting components of the works amounting to more than 10 percent of the Contract Price and

k) Permanent Income Tax No (PAN);
l) The bidders would give a declaration that they have not been banned or de listed by any Government or Quasi-govt. Agencies or PSU's. If a bidder has been banned by any Govt. or Quasi-Govt. Agencies or PSU's that fact must be clearly stated and it may not necessarily be a cause for disqualifying him. If this declaration is not given the bid will be rejected as non responsive.

m) Two or three companies/ contractors participating in the bid as Joint Venture should submit firm-wise participation details, Banker's name, execution of work with details of contribution of each and all other relevant details.

n) Service Tax registration with competent statutory authority.

o) Registration with CMPF authorities.

p) It is mandatory for all the bidders to sign Integrity Pact Documents. Tenders submitted without the Integrity Pact Documents will be summarily rejected and will not be considered for further evaluation.[refer to (a) clause 3.8 of this Section-2 for details and (b) Section-6 for the format of Integrity Pact].

[Note: The intending tenderer will have to submit a declaration in support of the authenticity of the credentials submitted by them along with the tender in the form of an affidavit as per the format provided in the bid document.]

3.4 To qualify for award of the contract - The intending bidder must have in its name as a prime contractor experience of having successfully completed similar works during last 7 ( seven) years ending last day of month previous to the one in which bid applications are invited should be either of the following

(a) Three similar completed works each costing not less than the amount of Rs. 41.60 Crores

Or

Two similar completed works each costing not less than the amount of Rs. 52.00 Crores.

Or

One similar completed work costing not less than the amount of Rs. 83.20 Crores.

Similar work means - Work related to planning, design, supply, construction and commissioning of Coal handling / Bulk material handling plant/ system consisting of crushers, feeders, with RCC bunker or Track hopper or Silo with belt conveyors system on turnkey basis.
(b) Average annual financial turnover of work during the last 3(three) years, ending 31st March of the previous financial year should be at least Rs. 31.20 Crores.

(c) Evidence of possessing adequate working capital of (at least Rs. 20.80 Crores) inclusive of access to lines of credit and availability of other financial resources to meet the requirement.

(d) Evidence of possessing adequate infrastructural support with respect to design, construction, manufacture/ supply of major equipment inclusive of legally bound back-up MOU/ Agreement with other agencies in the respective field of specialization as joint venture partners or sub-contractors.

3.5 Sub contractors experience and resources will not be taken into account in determining the bidder’s compliance with qualifying criteria.

3.6 Bidders who meet the minimum qualification criteria will be qualified only if their available bid capacity is more than the total bid value. The available bid capacity will be calculated as under:

Assessed available bid capacity = \( (A \times N \times 2 - B) \)

Where –
- \( A \): Maximum value of works executed in any one Year during the last five years (updated to current level) taking into account the completed as well as works in progress.
- \( N \): Number of years prescribed for completion of the Works for which bids are invited.
- \( B \): Value at current price level of existing commitments and ongoing works to be completed during the next 24 months.

[Note 1: Financial turnover and cost of completed works of previous works shall be given a weightage of 5% per year (average annual rate of inflation) to bring them at current price level.]

[Note 2: The statements showing the values of existing commitments and on going works as well as the stipulated period of completion remaining for each of the works listed should be countersigned by the engineer-in charge not below the rank of executive engineer.]

3.7 Even though the bidders meet the above qualifying criteria, they are subject to be disqualified if they have
a. made misleading or false representations in the forms, statements and attachments submitted in proof of the qualification requirement; and /or

b. record of poor performance such as abandoning the works, not properly completing the contract, inordinate delays in completion, litigation history, or financial failures etc.

3.8 It is mandatory for all the bidders to sign Integrity Pact Documents. Tenders submitted without the Integrity Pact Documents will be summarily rejected and will not be considered for further evaluation. (for format, refer to Section-6) as described in clause 3.3(p). Any bidder who does not submit this duly-signed document, shall be disqualified from participation in the tender process.

4.0 **ONE BID PER BIDDER**

4.1 Each Bidder shall submit only one Bid, either individually, or as a partner in a partnership firm or a partner in a joint venture or a public limited firm. A Bidder who submits or participates in more than one Bid (other than as a subcontractor or in cases of alternatives that have been permitted or requested) will cause all the proposals with the Bidder's participation to be disqualified.

5.0 **COST OF BIDDING**

5.1 The Bidder shall bear all costs associated with the preparation and submission of his Bid, and the Employer will in no case be responsible or liable for those costs.

6.0 **SITE VISIT**

6.1 The Bidder, at the Bidder's own responsibility, cost and risk, is encouraged to visit and examine the Site of Works and its surroundings and obtain all information that may be necessary for preparing the Bid and entering into a contract for construction of the Works. The costs of visiting the Site shall be at the Bidder's own expense.

6.2 It shall be deemed that the tenderer has visited the site/ area and got fully acquainted with the working conditions and other prevalent conditions and fluctuations thereto whether he actually visits the site/ area or not and has taken all the factors into account while quoting his rates and prices.

6.3 Site investigation reports: The contractor, in preparing the bid, shall rely on the site investigation report referred to in the contract data, supplemented
7.0 **CONTENT OF BIDDING DOCUMENTS**

7.1 The set of bidding documents comprises the documents listed in the table below and addenda issued in accordance with Clause 9:

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<th>Section - 1</th>
<th>Tender Notice</th>
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<td>Section - 8</td>
<td>Tender Drawings</td>
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</tbody>
</table>

8. **CLARIFICATION OF BIDDING DOCUMENTS**

8.1 A prospective Bidder requiring any clarification of the bidding documents may notify the Employer in writing or by cable (cable includes telex and facsimile) at the Employer's address indicated in the Notice Inviting Tender. The Employer will respond to any request for clarification received earlier than 15 days prior to the deadline for the submission of Bids. Copies of the Employer's response will be forwarded to all purchasers of the bidding documents, including a description of the enquiry but without identifying its source.

9.0 **AMENDMENT OF BIDDING DOCUMENTS**

9.1 Before the deadline for submission of Bids, the Employer may modify the bidding documents by issuing addenda. Any addendum thus issued shall be part of the bidding documents and shall be communicated in writing or by cable to all purchasers of the bidding documents. Prospective Bidders shall acknowledge receipt of each addendum by cable to the Employer.

9.2 To give prospective Bidders reasonable time in which to take an addendum into account in preparing their Bids, the Employer shall extend, as necessary, the deadline for submission of Bids, in accordance with Sub-clause 19.2 below. And the same is also to be communicated simultaneously to all the purchaser of the bidding document.

10.0 **LANGUAGE OF BID**

10.1 All documents relating to the Bid shall be in the English language.

11.0 **DOCUMENTS COMPRISING THE BID**

11.1 The Bid, comprising of three parts, will be submitted by the bidder in the following manner:

a. **Part I** of the bid to be submitted in 1st inner sealed envelope comprising of -
(i) Bid security/ Earnest money deposit, (refer to Sec. I Clause 3.)

(ii) Letter of the bidder submitting the bid in the form as stipulated in 'Contractor's bid' (refer to Sec. 2) of the Bid Document and

(iii) Qualification information as indicated in bid document (Section 2) and Documents as required in accordance with stipulations of Bidding Documents (Section 2) and any other materials required to be completed and submitted by bidder in accordance with these instructions.

(iv) Part-I (commercial) of tender document duly signed on all pages by the bidder as acceptance of all terms and condition of tender document.

b. **Part II** of the bid to be submitted in the 2nd inner sealed envelope comprising of

(i) Technical offer along with technical specifications of equipments / know how offered, drawings, pamphlets etc. strictly in terms of tender enquiry.

(ii) Commercial Terms and Conditions including payment terms in case deviating from those in the tender enquiry.

(iii) Part-II technical of the tender document (purchased copy from the owner or downloaded from the specified website) duly signed on all pages by the bidder as acceptance of all terms and conditions of the tender document.

c. **Part III** of the bid, to be submitted in 3rd inner sealed envelope, shall comprise of Price Bid only in the format as indicated in the tender documents (refer to Sec 5).

d. All the inner sealed envelopes will then be placed in one outer envelope, sealed and marked properly as per Clause 18 and submitted to the Employer at its address before the deadline for submission of the bid as described in Clause 19.

e. If the Bidding Documents are downloaded from the company's website, the Bidders shall deposit requisite Application Fee as the cost of Bidding Documents in the form of Bank Draft of scheduled bank drawn in favour of **Bharat Coking Coal Limited**, payable at **Dhanbad**. The bidders are also required to submit an undertaking that they will accept the Tender Documents as available in the website and their tender shall be rejected if any tampering in the tender document is found to be done at the time of opening of tender or there after during subsequent scrutiny. In case of any discrepancy
between the tender documents downloaded from the website and the master copy available in the office of the Employer, the latter shall prevail and will be binding on the tenderers. No claim on this account will be entertained. The Company shall not be responsible for any delay/difficulties in accessibility of the downloading facility for any reason, whatsoever. The downloading facility shall be available during the period of sale of Tender Documents.

The bank draft and the undertaking shall be submitted in a separate envelope marked "Cost of Tender Documents and the Undertaking" and not with Part I / EMD but will be put inside the outer sealed envelope (refer to para 'd' above).

12 BID PRICES

12.1 The contract shall be for the whole Works as described in Sub-Clause 1.1, based on the scope of work as detailed in the bidding document.

12.2 The Bidder shall submit rates and prices for all items of the Works described in the scope of works. Corrections, if any, shall be made by crossing out, initialing, dating and rewriting.

12.3 All duties, taxes and other levies payable by the Contractor under the Contract, or for any other cause shall be included in the rates, prices and the total Bid Price submitted by the Bidder. All incidentals, overheads, leads, lifts, carriages etc. as may be attendant upon execution and completion of works as stipulated in the bidding document shall also be included in the rates, prices and total Bid price submitted by the bidder.

12.4 The rates and prices quoted by the Bidder shall be fixed for the duration of the contract and shall not be subject to variations on any account except to the extent variations allowed as per the conditions of the contract indicated in clause no. 2.6 of section 4.2 (Additional Terms & Conditions of Contract) in the bidding document.

13.0 CURRENCIES OF BID AND PAYMENT

13.1 The unit rates and prices shall be quoted by the Bidder entirely in Indian Rupees.

14.0 Bid Validity:

14.1 Bid shall remain valid for a period not less than one hundred and eighty days (after the deadline for bid submission specified in clause-19). A bid valid for a shorter period shall be rejected by the Employer.

14.2 In exceptional circumstances, prior to expiry of the original time limit, the employer may request the bidders to extend the period of validity for a specified additional period. The request and the bidder's responses shall be made in writing or by cable. A bidder may refuse the request without
forfeiting his bid security. A bidder agreeing to the request will not be required or permitted to modify his bid but will be required to extend the validity of his bid security for a period of the extension and in compliance with clause no. 15 in all respects.

### 15.0 Bid Security/Earnest Money Deposit

15.0 The bidder shall furnish, as part of his bid, a Bid Security/ Earnest Money in the amount as shown in NIT for this particular work. Bid Security/ EMD will be required to be deposited in the form of irrevocable Bank Guarantee (from any Nationalised/Scheduled Bank Branch acceptable to the owner) with validity 28 days beyond the validity of the bid in the format given in the bid document. Certified Cheques and Demand Drafts will also be acceptable as Earnest Money/ Bid Security drawn in favour of Bharat Coking Coal Limited. Refer to clause #3 of section-1 about bank draft details (as for earnest money, other details and conditions of bank draft are applicable in this case also).

15.1 Any bid not accompanied by an acceptable Bid Security/ EMD and necessary documents for pre-qualifying criteria shall be rejected by the Employer as non-responsive.

15.2 The Bid Security/ EMD of the unsuccessful bidder shall be refundable as promptly as possible after opening of price bid and finalization of the tender.

15.3 The Bid Security/ EMD of the successful Bidder will be discharged when the Bidder has signed the agreement and furnished the required Performance Security/ Security Deposit.

15.4 The Bid Security / Earnest Money may be forfeited:

   a) if the Bidder withdraws the Bid after Bid opening during the period of Bid validity; or

   b) in the case of a successful Bidder, if the Bidder fails within the specified time limit to:

   (i) sign the Agreement;

   (ii) or furnish the required Performance Security/ Security Deposit.

   c) if the Bidder does not accept the correction of the bid price pursuant to clause 26 of ITB (Instructions To Bidders).

15.6 The Bid Security / EMD deposited with the Employer will not carry any interest.

### 16 Alternative proposals by bidders (This clause is not applicable to this tender)

16.1 Bidders shall submit offers that comply with the requirements of the Binding documents, including the basic technical design as indicated in the drawings and specifications. Alternatives will not be considered, unless specifically allowed in the Bidding Data. If so allowed, Sub-Clause 16.2
shall govern.

16.2 If so allowed in the Bidding Documents, Bidders wishing to offer technical alternatives to the requirements of the Bidding documents must also submit a Bid that complies with the requirements of the Bidding documents, including the basic technical design as indicated in the drawings and specifications. In addition to submitting the basic Bid, the Bidder shall provide all information necessary for a complete evaluation of the alternative by the Employer, including design calculations, technical specifications, breakdown of prices, proposed construction methods and other relevant details. Only the technical alternatives, if any, of the lowest evaluated Bidder conforming to the basic technical requirements stipulated in the Bidding Document shall be considered by the Employer.

17.0 Format and Signing of Bid

17.1 The Bidder shall prepare the bid documents comprising the Bid as described in Clause 11 of these Instructions to Bidders.

17.2 All documents of the Bid shall be typed or written in indelible ink and shall be signed by a person(s) duly authorized to sign on behalf of the Bidder, pursuant to Sub-Clauses 3.3(a). All pages of the Bid document shall be signed by the person(s) signing the Bid.

17.3 The Bid shall contain no alterations, or additions, except those to comply with instructions issued by the Employer, or as necessary to correct errors made by the Bidder, in which case such corrections shall be initialed by the person(s) signing the Bid. Erasing or overwriting in the Bid Document may disqualify the Bidder.

18. SEALING, MARKING AND SUBMISSION OF BIDS

18.1 The Bidder shall seal the Bid in three inner sealed envelopes and one outer sealed envelope, duly marking the inner envelopes in the following manner:

a) 1st inner sealed envelope will be marked “Part I- Bid for CHP with Silo loading arrangement at Maheshpur siding comprising of Bid Security/ EMD with qualification information”.

b) 2nd inner sealed envelope will be marked as “Part II- Technical and Commercial Parts for CHP with Silo loading arrangement at Maheshpur siding”.

c) 3rd inner sealed envelope will be marked “Part III- Price Bid for CHP with Silo loading arrangement at Maheshpur siding”.

d) Outer Sealed envelope will be marked "Bid Documents for CHP with Silo loading arrangement at Maheshpur siding."

18.2 The inner envelopes placed in the outer envelope shall:

a. be addressed to BCCL at the following address and submitted
accordingly before the deadline for submission of bid as indicated in Clause 19:

i) General Manger (CMC), Bharat Coking coal Limited, 5th Floor, Koyla Bhawan Complex, Dhanbad-826005, (JHARKHAND).

Or,

ii) Office of Chief Sales Manager BCCL
6, Lyons Range Kolkata-700001, India

b. inner and outer envelopes will bear the following additional identification:
- Bid for CHP with Silo loading arrangement at Maheshpur siding.
- Bid Reference No: CMPDI/TENDER/CGM(E&M)/2009/---

DO NOT OPEN BEFORE 16:00 HRS (IST) on -------------------

18.3 In addition to the identification required in Sub-Clause 18.2 the inner and outer envelopes shall indicate the name and address of the Bidder.

18.4 If the outer envelope is not sealed and marked as above, the Employer will assume no responsibility for the misplacement or premature opening of the Bid.

19. **DEADLINE FOR SUBMISSION OF BIDS**

19.1 Bids shall be delivered to BCCL at the address specified above not later than **15:30 Hrs. (IST) on 06.04.2010** In the event of the specified date for the submission of bids being declared a holiday for the Employer, the Bids will be received up to the appointed time on the next working day.

19.2 The BCCL may extend the deadline for submission of Bids by issuing an amendment in accordance with Clause 9, in which case all rights and obligations of the BCCL and the Bidders previously subject to the original deadline will then be subject to the new deadline.

20 **LATE BIDS**

20.1 Any Bid received after the deadline prescribed in Clause 19 due to any reason whatsoever will not be accepted.

21. **MODIFICATION AND WITHDRAWAL OF BIDS**

21.1 Bidders may modify or withdraw their Bids by giving notice in writing before the deadline prescribed in Clause 19 in case the bidder has submitted the bid well before the deadline or extended deadline.

21.2 Each Bidder's modification or withdrawal notice shall be prepared, sealed, marked and delivered in accordance with the provisions of Clause 11, 17, 18 and 19, with the outer and inner envelopes additionally marked
21.3 No Bid may be modified after the deadline for submission of Bids.

21.4 Withdrawal of a Bid between the deadline for submission of Bids and the expiration of the period of Bid validity specified in the Bid Document or as extended pursuant to Sub-Clause 14.2 may result in the forfeiture of the Bid Security pursuant to Clause 15.

22. **BID OPENING**

22.1 BCCL will open part I of the bids first, modifications made pursuant to Clause 21, in the presence of the bidders' or their representatives who choose to attend at the time and in the place specified in Clause 19. In the event of the specified date of Bid opening being declared a holiday for the Employer, the Bids will be opened at the appointed time and location on the next working day.

22.2 After examination and evaluation of part I of the bids in accordance with Cl. 25 of these instructions, Part II of the bids which are substantially responsive and fulfill the requisite eligibility criteria laid down under these instructions shall be opened.

22.3 Part III of the bids which are technically and commercially at par and substantially responsive in accordance with specifications, scope, terms and conditions and fulfilling the requirements of the instructions to the bidders, shall be opened.

22.4 Envelopes marked "WITHDRAWAL" shall be opened and read out first. Bids for which an acceptable notice of withdrawal has been submitted pursuant to Clause 21 shall not be opened.

22.5 The Bidders' names, the Bid Prices, the total amount of each Bid and of any alternative Bid (if alternatives have been requested or permitted), any discounts, Bid modifications and withdrawals, the presence or absence of Bid Security, and such other details as the employer may consider appropriate, will be announced by employer at the opening.

23.0 **PROCESS TO BE CONFIDENTIAL**

23.1 Information relating to the examination, clarification, evaluation and comparison of Bids and recommendations for the award of a contract shall not be disclosed to Bidders or any other persons not officially concerned with such process until the award to the successful Bidder has been announced. Any effort by a Bidder to influence the Employer's processing of Bids or award decisions may result in the rejection of his Bid.

24.0 **CLARIFICATION OF BIDS**

24.1 To assist in the examination, evaluation, and comparison of Bids, the Employer may, at the Employer's discretion, ask any Bidder for clarification of the Bidder's Bid, including breakdowns of unit rates. The request for clarification and the response shall be in writing or by cable,
25.0 EXAMINATION OF BIDS AND DETERMINATION OF RESPONSIVENESS

25.1 Prior to the detailed evaluation of Bids, the Employer will determine whether each Bid:

a. meets the eligibility criteria defined in Clause 3;
b. has been properly signed;
c. is accompanied by the required securities; and
d. is substantially responsive to the requirements of the Bidding documents.

25.2 A substantially responsive Bid is one which conforms to all the terms, conditions, and specifications of the Bidding documents without material deviation or reservation is one

a. which affects in any substantial way the scope, quality, or performance of the works;
b. which limits in any substantial way, inconsistent with the Bidding documents, the Employer's rights or the Bidder's obligations under the Contract; or
c. whose rectification would affect unfairly the competitive position of other Bidders presenting substantially responsive Bids.

25.3 If a Bid is not substantially responsive, it may be rejected by the Employer at its sole discretion.

26. CORRECTION OF ERRORS

26.1 Bids determined to be substantially responsive will be checked by BCCL for any arithmetical errors. Errors will be corrected by BCCL as follows:

a. where there is a discrepancy between the amounts in figures and in words, the amounts in words will govern; and
b. where there is a discrepancy between the unit rate and the line item total resulting from multiplying the unit rate by the quantity, the unit rate as quoted will govern.
c. discrepancy in totaling or carry forward in the amount quoted by the contractor shall be corrected.

The tendered sum so corrected and altered shall be substituted for the sum originally tendered and considered for acceptance instead of the original sum quoted by the tenderer along with other tender(s). Rounding off to the nearest rupee should be done in the final summary of the amount instead of in totals of various sections of the offer.

26.2 The amount stated in the Bid will be adjusted by BCCL in accordance with
the above procedure for the correction of errors and, shall be considered as binding upon the Bidder.

27 EVALUATION AND COMPARISON OF BIDS

27.1 BCCL will evaluate and compare only the Bids determined to be substantially responsive in accordance with Clause 25.

27.2 In evaluating the Bids, BCCL will determine for each Bid the evaluated Bid Price by adjusting the Bid Price as follows:

a. Making any correction for errors pursuant to Clause 25.

b. Making an appropriate adjustment for any other quantifiable acceptable variations, deviations or alternative offers submitted in accordance with Clause 16 and

c. Making appropriate adjustments to reflect discounts or other price modifications offered in accordance with Clause 20.

27.3 The Employer reserves the right to accept or reject any variation, deviation, or alternative offer and other factors that are in excess of the requirements of the Bidding documents or otherwise result in unsolicited benefits for the employer shall not be taken into account in Bid evaluation.

27.4 If the Bid of the successful Bidder is seriously unbalanced in relation to the Engineer's estimate of the cost of work to be performed under the contract, the Employer may require the Bidder to produce detailed price analyses for any or all items of the work, to demonstrate the internal consistency of those prices with the construction methods and schedule proposed.

28 BCCL’S RIGHT TO ACCEPT ANY BID AND TO REJECT ANY OR ALL BIDS

29.0 Notwithstanding Clause 27, the Employer reserves the right to accept or reject any Bid, and to cancel the bidding process and reject all Bids, at any time prior to the award of Contract, without thereby incurring any liability to the affected Bidder(s) or any obligation to inform the affected Bidder(s) of the grounds for CMPDI's action.
30.0 NOTIFICATION OF AWARD AND SIGNING OF AGREEMENT

30.1 The Bidder, whose Bid has been accepted, will be notified of the award by the Employer prior to expiration of the Bid validity period by cable, telex, or facsimile confirmed by registered letter. This letter (hereinafter and in the Conditions of Contract called the "Letter of Acceptance") will state the sum that the Employer will pay the Contractor in consideration of the execution, completion and maintenance of the Works by the Contractor as prescribed by the Contract (hereinafter and in the Contract called "the Contract Price").

30.2 The notification of award will constitute the formation of the Contract, subject only to the furnishing of a Performance Security/Security Deposit in accordance with Clause 31.

30.3 The Agreement will incorporate all agreements between the Employer and the successful Bidder within 28 days following the notification of award along with the Letter of Acceptance.

30.4 Upon the furnishing by the successful Bidder of the Performance Security/Security Deposit, the Employer will promptly notify the other Bidder that their Bids have been unsuccessful and refund the Bid Security/Earnest Money Deposit.

30.5 Bidders are required to submit the duly-signed ‘Integrity Pact’ (for format, refer to Section-6).

31.0 PERFORMANCE SECURITY/ SECURITY DEPOSIT/

PERFORMANCE GUARANTEE

31.1 Security deposit shall consist of two parts

a) Performance security to be submitted at award of work and

b) Retention money to be recovered from running bills. The security deposit shall bear no interest

31.1.1 Performance security should be 5% of contract amount and should be submitted within 28 days of receipt of the Letter of Acceptance by the successful Bidder in any of the form given below after which the bid security/earnest money will be refunded to the contractor.

- A bank Guarantee on a bank as indicated by the employer in the form given in section-8 from any Nationalised/scheduled Indian bank or Govt. Securities, FDR or any other form of deposit stipulated by the owner. Or,

- Demand Draft for the full amount of contract performance security drawn in favour of Bharat Coking Coal Limited. Refer to clause #2 of section-1 about bank draft details. (as for earnest money, other details and conditions of bank draft are applicable in this case also).
31.1.2 If performance security is provided by the successful bidders in the form of bank guarantee it shall be issued either –

(a) at Bidder’s option by a Nationalized/ Scheduled Indian Bank or

(b) by a foreign Bank located in India and acceptable to the Employer.

31.1.3 Retention Money should be deducted at 5% from running bills. Total of performance security and Retention Money should not exceed 10% of contract amount or lesser sum indicated in the bid document.

31.2 The Guarantee amount shall be payable to the Employer without any condition whatsoever.

31.3 The Performance Guarantee shall cover additionally the following guarantees to the Employer:

(a) The successful bidder guarantees the successful and satisfactory operation of the equipment furnished and erected under the contract, as per the specifications and documents,

(b) The successful bidder further guarantees that the equipment provided and installed by him shall be free from all defects in design, material and workmanship and shall upon written notice from the employer fully remedy free of expenses to the Employer such defects as developed under the normal use of the said equipment within the period of guarantee specified in the relevant clause of the Conditions of Contract.

31.4 The Contract Performance Guarantee is intended to secure the performance of the entire Contract. However it is not construed as limiting the damages under clause entitled 'Equipment Performance Guarantee' in section Technical Conditions of Contract and damages stipulated in the other clauses in the bidding documents.

31.5 Bank Guarantee is to be submitted in the format prescribed by the company in Section-6. Bank Guarantee shall be irrevocable and it shall be from any Nationalised Bank/ Scheduled Bank.

31.6 The Company shall be at liberty to deduct/ appropriate from the Contract Performance Guarantee/ Security Deposit such sums as are due and payable by the contractor to the company as may be determined in terms of the contract, and the amount appropriated from the Contract Performance Guarantee/ Security Deposit shall have to be restored by Contractor subsequently.

31.7 The Contract Performance Guarantee will be returned to the Contractor without any interest at the end of the Guarantee Period.
31.8 Failure of the successful Bidder to comply with the requirements of Sub-Clause 31.1 shall constitute sufficient grounds for cancellation of the award and forfeiture of the Bid Security.

31.9 Performance Security/ Security Deposit shall be converted into Performance Guarantee on successful completion of work in accordance with contract and upon satisfactory trial operations and shall be valid for 90 days after the end of Guarantee period.

32. **EMPLOYMENT OF LOCAL LABOUR**

32.1 "Contractors are to employ, to the extent possible, only local project affected people and pay wages not less than the minimum wages fixed by the local Government".

33 **LEGAL JURISDICTION**

33.1 Matter relating to any dispute or difference arising out of this tender and subsequent contract awarded based on the bid shall be subject to the jurisdiction of Dhanbad Court, or Ranchi High Court, Jharkhand (India) only.

34.0 **DEEMED EXPORTS**

34.1 If the bidder has quoted any item(s) under the deemed exports then it will be the responsibility of the Bidder to get all the benefits under deemed exports from the Government. The Company's responsibility shall only be limited to the issuance of required certificates. The quotation of the Bidder will be unconditional and phrases like "Subject to availability of deemed exports benefit" will not find place in it.

35 **CONSULTANTS NOT TO BID & VICE-VERSA**

35.1 A firm which has been engaged by the Company to provide Goods or Works for a project or any of its affiliates will be barred from providing consultancy services for the same project. Conversely, a firm hired to provide consultancy services for the preparation or implementation of a project and any of its affiliates will be barred from subsequently providing Goods or Works or services related to the initial assignment for the same project.

36 **SUB-CONTRACTOR/ SUB-VENDOR**

36.1 The contract agreement will specify major items of supply of services for which the contractor proposes to engage Sub-Contractor/ Sub-Vendor. The contractor may from time to time propose any addition or deletion from any such list and will submit the proposals in this regard to the Engineer in Charge/ Designated Officer in Charge for approval well in advance so as not to impede the progress of work. Such approval of the Engineer in Charge/ Designated Officer will not relieve the contractor from any of his obligation, duties and responsibilities under the contract.
36.2 If a contractor submits his bid, qualifies and does not get the contract because of his not being the lowest, he will be prohibited from working as a sub-contractor for the contractor who is executing the work.
SECTION -3

FORMS OF BID & QUALIFICATION INFORMATION
SECTION - 3

FORMS OF BID AND QUALIFICATION INFORMATION

CONTRACTOR’S BID

Sub: BID for the Work ________________________________

To: ________________________________________________

Dear Sir,

We offer to execute the Works described above in accordance with the Conditions of Contract accompanying the Bidding Documents issued to us. The Bid Security/ Earnest Money in accordance with the NIT/ Tender Notice and Instructions to Bidders amounting to Rs ............... (in figures) ...................... .......................... ( in words ) in the form as stipulated in Clause 15 of the Instructions to Bidders is enclosed herewith (to be filled in by the Bidder).

This Bid and your written acceptance of it shall constitute a binding contract between us. We understand that you are not bound to accept the lowest or any Bid you receive.

We hereby confirm that this Bid complies with the Bid validity and Bid security required by the Bidding documents. We also confirm that EMD and other required documentary evidences related to this part of the Bid are enclosed (as listed below) herewith either in original/ copy attested by Gazetted Officer / copy duly authenticated by us with signature and seal along with affidavit as per the format provided in the bidding documents.

Yours faithfully,

Authorised Signature : ___________________________
Name and Title of the Signatory : ____________________
Name of the Bidder : ______________ (the Contractor)
Address : ______________________________________
Date : ______________________________
(To be filled in by the Bidder )

Encl. i) EMD of Rs………… vide ............. dt. ...........
ii)
iii
iv
QUALIFICATION INFORMATION
(The information to be submitted by all the Bidders)

1.0 Individual Bidders or Individual Members of Joint Ventures

1.1 Constitution or Legal status of Bidder (attach copy)

Place of registration: ______________________________
Principal place of business: ______________________________
Power of Attorney of signatory Bid: (attach)

1.2 Details of the turnover during last 3 (three) years:

<table>
<thead>
<tr>
<th>Year</th>
<th>Turnover in Rs.</th>
<th>Remarks</th>
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1.3 Joint Venture details:

Name of all partners of a joint venture
1. Lead partner
2. Partner
3. Partner

Notes: Joint ventures must comply the following requirements:

i) Following are the minimum qualification requirements for joint ventures
   a) The lead partner shall meet not less than 40% of all the qualifying criteria stated in the bidding documents.
   b) The other partners shall meet not less than 30% of all the qualifying criteria stated in the bidding documents.

ii) The formation of joint venture or change in the joint venture character / partners after submission of the bid and any change in the bidding regarding joint venture will not be permitted.

iii) Any bid shall be signed so as to legally bind all partners jointly and severally and any bid shall be submitted with a copy of the Joint Venture Agreement (JV agreement) providing the joint and several liability with respect to the contract.

iv) The pre qualification of a joint venture does not necessarily pre qualify any of its partners individually or as a partner in any other joint venture or association. In case of dissolution of a joint venture, each one of the constituent firms may pre qualify if they meet all the pre qualification requirements, subject to the written approval of the employer.

v) The bid submission must include documentary evidence to the relationship between joint venture partners in the form of JV Agreement to legally bind all partners jointly and severally for the proposed agreement, which should set out the principals for the constitution, operation, responsibilities regarding work and financial arrangements, participation (percentage share in the total) and liabilities (joint and several) in respect of each and all of the firms in the joint venture. Such
JV Agreement must evidence the commitment of the parties to bid for the facilities applied for (if pre-qualified) and to execute the contracts for the facilities if their bid is successful.

vi) One of the partners responsible for performing a key component of the contract shall be designated as Lead Partner, this authorization shall be evidenced by submitting with the Bid a Power of Attorney signed by legally authorized signatories of all the partners.

vii) The JV agreement must provide that the Lead Partner shall be authorized to incur liabilities and receive instructions for and on behalf of any and all partners of the joint venture and the entire execution of the contract shall be done with the active participation of the Lead Partner.

viii) The contract agreement should be signed jointly by each Joint Venture Partners.

ix) An entity can be a partner in one Joint Venture. Bid submitted by Joint Ventures including the same entity as partners will be rejected.

1.4 Details of experience for similar nature and complexity of work:

Use a separate sheet for each contract (Attach performance certificates from concerned customer).

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Number of contract :</td>
<td></td>
</tr>
<tr>
<td>Name of contract :</td>
<td></td>
</tr>
<tr>
<td>2. Name of the employer :</td>
<td></td>
</tr>
<tr>
<td>3. Employers address :</td>
<td></td>
</tr>
<tr>
<td>4. Nature of work and special features, if any :</td>
<td></td>
</tr>
<tr>
<td>5. Contract role (check one )</td>
<td></td>
</tr>
<tr>
<td>1. Sole contractor 2. Subcontractor 3. Partner in Joint venture</td>
<td></td>
</tr>
<tr>
<td>6. Value of the total contract</td>
<td></td>
</tr>
<tr>
<td>7. Date of award :</td>
<td></td>
</tr>
<tr>
<td>8. Date of completion with original schedule and slippage, if any.</td>
<td></td>
</tr>
<tr>
<td>9. Specified requirements :</td>
<td></td>
</tr>
<tr>
<td>a) concrete :</td>
<td></td>
</tr>
<tr>
<td>b) structural steelworks :</td>
<td></td>
</tr>
<tr>
<td>c) equipment :</td>
<td></td>
</tr>
</tbody>
</table>

1.5 Subcontractors/ Consultants and firms proposed to be involved :  
(Attach performance credentials including Bio-data of design personnel of Consultants)

<table>
<thead>
<tr>
<th>Section of work</th>
<th>Approx.. value of sub-contract</th>
<th>Sub-contractor (Name &amp; Address)</th>
<th>Experience in similar works</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1.6 Information on Bid Capacity.  
Works for which bids have been submitted and work which are yet to be completed as on the date of this bid :  
   a. Total value of work executed in last five years (year wise):.  
   b. Details of existing commitments and ongoing works.  
   c. Details of Works for which bids already submitted.
1.7 **Financial reports of the last five years : balance sheets, profit and loss statement, auditors report etc.** (copies to be submitted and the following format be filled up)

<table>
<thead>
<tr>
<th>Financial information in Rs.</th>
<th>Actual: Previous five years</th>
<th>Projected: Next two years</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Total assets</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2. Current assets</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. Total liabilities</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>4. Current liabilities</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>5. Profits Before taxes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Profits After taxes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1.8 **Evidence of access to financial resources to meet the qualification requirements:**

Cash in hand, liquid assets, unencumbered real assets, lines of credit and other financial means etc. sufficient to meet the construction cash flow (the copies to be submitted and the following format to be filled up)

<table>
<thead>
<tr>
<th>Source of financing</th>
<th>Amount in Rs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
</tr>
</tbody>
</table>

1.9 **Details of the bankers : Give details for e-payment also**

<table>
<thead>
<tr>
<th>Banker</th>
<th>Name of the banker</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Address of the banker</td>
</tr>
<tr>
<td></td>
<td>Telephone</td>
</tr>
<tr>
<td></td>
<td>Contact name and title</td>
</tr>
<tr>
<td></td>
<td>Fax</td>
</tr>
<tr>
<td></td>
<td>Telex</td>
</tr>
<tr>
<td></td>
<td>Account number</td>
</tr>
<tr>
<td></td>
<td>Contractor has to give authorisation duly signed for E-payment to them</td>
</tr>
</tbody>
</table>

1.10 **Information about litigations, if any, in which bidder is involved:**

<table>
<thead>
<tr>
<th>Year</th>
<th>Award FOR or AGAINST applicant</th>
<th>Name of the client, Clause of Litigation and Matter of dispute</th>
<th>Disputed amount in Rs.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1.11 **Details of the major construction equipment to be used for the work :**

<table>
<thead>
<tr>
<th>Equipment type and capacity</th>
<th>Make and model</th>
<th>Minimum number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1.12 Details of additional construction equipment to be purchased new for the project, indicating delivery times required in the form given below:

<table>
<thead>
<tr>
<th>Equipment to be purchased new</th>
<th>Make and model</th>
<th>Delivery period</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>type and capacity</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1.13. Personnel capabilities
The applicant must have suitably qualified personnel to fill the following key positions for the project. The applicant will supply information on a prime candidate and an alternate for each positions both of whom, wherever possible meet the experience requirements as specified in format below:

<table>
<thead>
<tr>
<th>Position</th>
<th>Name</th>
<th>Total post qualification experience (years)</th>
<th>In similar Works (years)</th>
<th>As Manager or Section Leader of Similar Works (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Manager</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alternative name</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site engineers of respective discipline</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alternative names</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost controller</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alternative name</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality Assurance Engineer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alternative name</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site supervisors of resp. disc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alternative names</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1.14 The bidder should list transport available for personnel, construction, plant, stores and machinery. Where transport is to be subcontracted the proposed arrangements should be clearly demonstrated.

1.15 The bidder should provide full details of his plant and maintenance facilities together with the full details of laboratory personnel, workshop personnel including fitters, mechanics, machinists etc.

1.16 Permanent Income Tax Account No. (PAN)

1.17 DETAILS OF EARNEST MONEY/ PERFORMANCE SECURITY

Deposit of Earnest Money by:
Draft No. :  
Drawn on :  
Amount (Rs.) :  

Bank Guarantee Details:
Name of the Bank :  
Amount of BG. :  
Bank Guarantee valid upto :  

1.18 OTHER DETAILS

(a) Details of registration/ enlistment with Government organisations/ PSUs/ Subsidiaries of Coal India.

(b) Certificate of registration as per statutory requirements under Sales Tax, Contract Labour Laws etc. as may be applicable

(A) Existing commitments and on going works

<table>
<thead>
<tr>
<th>Desc. of works</th>
<th>Place &amp; state</th>
<th>Contract no &amp; date</th>
<th>Name &amp; address of employer</th>
<th>Value of contract (Rs million)</th>
<th>Stipulated period of completion</th>
<th>Value of remaining to be completed</th>
<th>Anticipated date of completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
</tbody>
</table>

Signature of the Tenderer

Along with Seal/ Stamp

NOTE: 1. Separate sheets may be attached to furnish details, if necessary.
2. All information furnished shall be serially arranged and supported with documentary evidence, bankers certificate, performance certificates from customers etc.
AFFIDAVIT
(NON JUDICIAL STAMP PAPER OF Rs 50/-)

I…………………………………………………………………………………….
…………………….. Partner/Legal Attorney Proprietor/Accredited Representative of
M/s. ………………………………………………. Solemnly declared that :

1. I/We are submitting tender for the work
………………………………………………………………………………
………………………………………………………………………………
against Tender Notice No. --------------- dated ---------

2. None of the partners of our firm is relative of employee of Bharat Coking Coal Limited and
CMPDI.

3 All information furnished by me / us in respect of fulfilment of eligibility criteria and
information given in this Bid is complete, correct and true.

4. All documents / credentials submitted along with this tender are genuine, authentic, true and
valid.

5. If, any information or document submitted is found to be false /incorrect at any time, Employer
may cancel my Bid and action as deemed fit may be taken against me /us including termination
of the contract, forfeiture of all dues including Earnest Money and blacklisting of our firm and
all Partners of the firm etc.

Signature of the Tenderer

Dated --------------

Seal of Notary
SECTION -4

CONDITIONS OF CONTRACT
SUB-SECTION – 4.1

GENERAL TERMS AND CONDITIONS OF CONTRACT

1. DEFINITIONS:

i. The word "Company" or "Employer" or "Owner" wherever occurs in the conditions, means the Bharat Coking Coal Limited, Koyla Bhawan Complex, Dhanbad, represented at the headquarters of the Company by the Chairman-cum-Managing Director or his authorised representative or any other officer specially deputed for the purpose.

ii. The word "Principal Employer" or "Engineer" wherever occurs, means the authorised representative or any other officer specially deputed by the Company for the purpose of contract.

iii. The word "Contractor"/"Contractors" or "Manufacturer" wherever occurs means the successful Bidder/Bidders who has/have deposited the necessary Earnest Money and has/have been given written intimation about the acceptance of tender and has/have been given written intimation about the acceptance of tender and shall include legal representative of such individual or persons composing a firm or a company or the successors and permitted assignees of such individual, firm or company, as the case may be.

iv. "The Site" shall mean the site of the contract work including land and any building and erections thereon and any other land allotted by the company for contractor's use in the performance of the contract.

v. The term "sub-contractor", as employed herein, includes those having a direct contract with contractor either on piece rate, items rate, time rate or on any other basis and it includes one who furnishes work to a special design according to the plans or specifications of this work but does not include one who merely supplied materials.

vi. "Consulting Engineer"/"Consultant" shall mean any firm or person duly appointed as such from time to time by the owner.

vii. 'Accepting authority' shall mean the management of the company and includes an authorised representative of the company or any other person or body of persons empowered in this behalf by the company.

viii. A 'Day' shall mean a day of 24 hours from midnight to midnight.

ix. Engineer-in-charge/Designated Officer-in-charge will be clearly defined in the contract document. Engineer-in-charge/Designated Officer-in-charge who is of an appropriate seniority will be responsible for supervising and administering the contract, certifying payment due to the contractor, valuing variations to the contract, awarding extension of time and valuing compensation events. Engineer-in-charge/Designated Officer-in-charge may further appoint his representatives i.e. another person/Project Manager or any other competent person and notify to the contractor who is directly responsible for supervising the work being executed at the site, on his behalf under the Delegation of Powers of the company. However, overall responsibility, as far as the contract is concerned will be that of the Engineer-in-charge/Designated Officer-in-charge.

x. The 'contract' shall mean the notice inviting tender, the tender as accepted by the company and the formal agreement executed between the company and the contractor together with the documents referred to therein including conditions of contract, special conditions, if any,
specifications, designs & drawings including those to be submitted during progress of work, scope of work, billing schedule/schedule of quantities with rates and amounts.

xi. The 'works' shall mean and include the furnishing of equipment, labour, and the services in accordance with the contract or parts thereof as the case may be and shall also include all extra or additional, altered or substituted works or any work of emergent nature, which in the opinion of the Engineer-in-charge, become necessary during the progress of the works to obviate any risk or accident or failure or become necessary for security.

xii. "Specification" shall mean the technical specifications forming a part of the contract and such other schedules and drawings as may be mutually agreed upon.

xiii. 'Contract price' shall mean the total sum for which tender is accepted by the company.

xiv. 'Written notice' shall mean a notice or communication in writing and shall be deemed to have been duly served if delivered in person to the individual or to a member of the firm or to an office of the Corporation/Company for whom it is intended, or if delivered at or sent by registered mail to the last business address known to him who gives the notice.

xv. "Letter of Acceptance" of the tender shall mean the official notice issued by the company notifying the contractor that his tender has been accepted.

xvi. "Date of Contract" shall mean the date on which both the parties have signed the contract agreement.

xvii. "Manufacturer's Works' or Contractor's Works" shall mean the place of work used by the Manufacturer, the Contractor, their collaborators or sub-contractors for the performance of the works.

xviii. "Inspector" shall mean the Owner or any person nominated by the Owner from time to time, to inspect the equipment stores or Works under the contract and/or the duly authorised representative of the owner.

xix. When the words "Approved", "Subject to Approval", "Satisfactory", "Equal to", "Proper", "Requested", "As directed", "Where directed", "When directed", "Determined by", "Accepted", "Permitted", or words and phrases of like import are used, the approval, judgement, direction etc. is understood to be a function of the Owner/Engineer/Engineer-in-Charge.

xx. "Test of Completion" shall mean such tests as prescribed in the contract to be performed by the contractor before the Works is taken over by the Owner.

xxi. "Start-up" shall mean the time period required to bring the equipment covered under the Contract from an inactive condition, when construction is essentially complete, to the state ready for trial operation. The start-up period shall include preliminary inspection and check out of equipment and supporting sub-systems; initial operation of the complete equipment covered under the Contract to obtain necessary pre-trial operation data, perform calibration and corrective action; shut down inspection and adjustment prior to the trial operation period.

xxii. "Initial operation" shall mean the first integral operation of the complete equipment covered under the contract with sub-systems and supporting equipment in service.

xxiii. "Trial Operation", "Reliability Test", "Trial Run", "Complete Test" shall mean the extended period of time after the "Start-up" period. During this trial operation period the unit shall be operated over the full load range. The length of Trial Operation shall be as determined by the Engineer, unless otherwise specified elsewhere in the Contract.
xxiv. "Performance and Guarantee Tests" shall mean all operation checks and tests required to determine and demonstrate capacity, efficiency, and operating characteristics as specified in the contract document.

xxv. "Commercial Operation" shall mean the condition of operation in which the complete equipment covered under the contract is officially declared by the owner to be available for continuous operation at different loads up to and including rated capacity. Such declaration by the owner however, shall not relieve or prejudice any of the contractor's obligations under this contract.

xxvi. "Final Acceptance" shall mean the owner's written acceptance of the works performed under the contract, after successful completion of performance and guarantee tests.

xxvii "Guarantee Period/Maintenance Period" shall mean the period during which the contractor shall remain liable for repair or replacement of any defective part of the works performed under the contract.

xxviii "Drawings"/"Plans" shall mean all:

(a) drawings furnished by the owner/consultant as a basis for proposals,
(b) supplementary drawings furnished by the Owner/Consultant to clarify and to define in greater detail the intent of the contract,
(c) drawings submitted by the contractor with his proposal provided such drawings are acceptable to the Owner/Consultant,
(d) drawings furnished by the Owner/Consultant to the Contractor during the progress of the work, and
(e) engineering data and drawings submitted by the Contractor during the progress of the work provided such drawings are acceptable to the Engineer,

xxix "Codes" shall mean the following, including the latest amendments, and/or replacements, if any:

(a) Standards of Bureau of Indian Standards relevant to the works under the contract and their specifications.
(b) Other Internationally approved Standards and/or rules and regulations touching the subject matter of the contract.
   (i) A.S.M.E. Test codes.
   (ii) A.I.E.E. Test codes.
   (iii) American Society of Materials Testing Codes.
   (iv) Indian Electricity Act and Rules and Regulations made thereunder.
   (v) Indian Explosive Act and Rules and Regulations made thereunder.
   (vi) Indian Petroleum Act and Rules and Regulations made thereunder.
   (vii) Indian Mines Act and Rules and Regulations made thereunder.
(c) Any other laws, rules, regulations and Acts applicable in the country with respect to labour, safety, compensation, insurance etc.

xxx Words importing singular only shall also include the plural and vice-versa where the context so requires.

xxx Words importing "Person" shall include firms, companies, corporations, and associations or bodies of individuals, whether incorporated or not.

xxxii Terms and expressions, not defined herein, shall have the same meaning as are assigned to them in the Indian Sale of Goods Act, failing that in the Indian Contract Act, and failing that in the General Clauses Act.
"Commissioning" the plant/project shall mean completion in all respects of construction rendering the plan/project ready for performance test and commercial operation as per xxv.

"Government Approvals" shall mean all permits, licenses, authorisations, consents, clearances, decrees, waivers, privileges, approvals from and filing with government instrumentalities necessary for the development, construction and operation of the plant/project.

"Month" shall mean a calendar month according to the Gregorian calendar.

"Bank Guarantee" shall mean the Bank Guarantee to be provided by ......................... to .............

2. CONTRACT DOCUMENTS:

The following documents shall constitute the contract documents:

(i) Articles of Agreement,
(ii) Notice Inviting Tender,
(iii) Letter of Acceptance of Tender indicating deviations, if any, from the conditions of contract incorporated in the Tender Documents issued to the bidder and/or the Bid submitted by the bidder,
(iv) Conditions of contract, including general terms and conditions, additional terms and conditions, technical terms and conditions, erection terms and conditions, special conditions, if any etc. forming part of the Agreement,
(v) Specifications, where it is part of Tender Documents,
(vi) Scope of works/ Bills of quantities/ schedule of works/ quantities and
(vii) Contract Drawings/ finalized work programme.

2.1 After acceptance of tender the Contractor shall be deemed to have carefully examined all Contract Documents to his satisfaction. If he shall have any doubt as to the meaning of any portion of the Contract Documents, he shall before signing the Contract, set forth the particulars thereof, and submit them to the Owner in writing in order that such doubt may be removed. The Owner will provide such clarifications as may be necessary in writing to the Contractor. Any information otherwise obtained from the Owner or the Engineer shall not in any way relieve the Contractor of his responsibility to fulfill his obligations under the Contract.

2.2 The Contractor shall enter into a Contract Agreement with the Owner within 60 (sixty) days from the date of 'Acceptance of Tender' or within such extended time as may be granted by the owner. The performance Bank Guarantee for the proper fulfillment of the contract shall be furnished by the contractor in the prescribed form within 30 (thirty) days of 'Acceptance of tender'. The performance Guarantee shall be as per terms prescribed in clause 31 of Instructions to Bidders of this tender.

2.3 The owner, after the issue of the Letter of Acceptance of Tender, will send one copy of the final agreement to the contractor for his scrutiny and approval.

2.4 The agreement, unless otherwise agreed to, shall be signed within 60 (sixty) days of the issue of the letter of Acceptance of tender, at the office of the owner on a date and time to be mutually agreed. The contractor shall provide for signing of the contract, performance guarantee in copies as required, appropriate power of attorney and other requisite materials. In case it is agreed mutually that the contract is to be signed beyond the stipulated time, the bid guarantee submitted with the tender will have to be extended accordingly.
2.5 The agreement will be signed in six originals and the contractor shall be provided with one signed original and the rest will be retained by the owner. None of these documents shall be used by the contractor for any purpose other than this contract and the contractor shall ensure that all persons employed for this contract strictly adhere to this and maintain secrecy, as required of such documents.

2.6 The contractor shall provide free of cost to the owner all the engineering data, drawings and descriptive materials submitted with the bid, in at least six (6) copies to form a part of the contract immediately after issue of letter of acceptance.

2.7 Subsequent to signing of the contract, the contractor at his own cost shall provide the owner with at least 6 (six) true copies of agreement within 30 (thirty) days after the signing of the contract.

2.8 The contract shall be considered as having come into force from the date of the letter of acceptance of tender issued by the owner.

2.9 The laws applicable to this contract shall be the laws in force in India. The courts of Jharkhand State, India shall have exclusive jurisdiction in all matters arising under this contract.

3.0 CONTRACT PERFORMANCE GUARANTEE/ SECURITY DEPOSIT:

3.1 Security deposit shall consist of two parts

a. Performance security to be submitted at award of work and
b. Retention money to be recovered from running bills. The security deposit shall bear no interest

3.1.1 Performance security should be 5% of contract amount and should be submitted with in 28 days of receipt of the Letter of Acceptance, the successful Bidder in any of the form given below after which bid scrutiny/ earnest money will be refunded to the contractor.

- Bank Guarantee on a bank indicated by the Employer in the form given in Section 8 from any scheduled Indian Bank for full amount of 5% of the contract price after which the Bid Security/ Earnest Money will be refunded to the contractor.

or

- Bank draft for the full amount of Contract Performance Security/ Security Deposit amounting to 5% of the contract price, in favour of Bharat Coking Coal Limited. Refer to clause 2 of section-1 about bank draft details (as for earnest money, other details and conditions of bank draft are applicable in this case also).

3.1.2 If performance security is provided by the successful bidders in the form of bank guarantee it shall be issued either –

(a) at Bidder’s option by a nationalized/ Scheduled Indian Bank or

(b) by a foreign bank located in India and acceptable to the employer.

3.1.3 Retention Money should be deducted at 5% from running bills. Total of performance security and Retention Money should not exceed 10% of contract amount or lesser sum indicated in the bid document.

3.2 Bank Guarantee shall be valid up to ninety (90) days after the end of Guarantee Period.
3.3 The Guarantee amount shall be payable to the Employer without any condition whatsoever.

3.4 The Performance Guarantee shall cover additionally the following guarantees to the Employer:

(a) The successful bidder guarantees the successful and satisfactory operation of the equipment furnished and erected under the contract, as per the specifications and documents,

(b) The successful bidder further guarantees that the equipment provided and installed by him shall be free from all defects in design, material and workmanship and shall upon written notice from the Employer fully remedy free of expenses to the Employer such defects as developed under the normal use of the said equipment within the period of guarantee specified in the relevant clause of the Conditions of Contract.

3.5 The Contract Performance Guarantee is intended to secure the performance of the entire Contract. However it is not construed as limiting the damages under clause entitled 'Equipment Performance Guarantee' in section Technical Conditions of Contract and damages stipulated in the other clauses in the bidding documents.

3.6 Bank Guarantee is to be submitted in the format prescribed by the company in Section 8. Bank Guarantee shall be irrevocable and it shall be from any Nationalised Bank/ Scheduled Bank.

3.7 The Company shall be at liberty to deduct/ appropriate from the Contract Performance Guarantee/Security Deposit such sums as are due and payable by the contractor to the company as may be determined in terms of the contract, and the amount appropriated from the Contract Performance Guarantee/Security Deposit shall have to be restored by Contractor subsequently.

3.8 The Contract Performance Guarantee will be returned to the Contractor without any interest at the end of the Guarantee Period.

4.0 ASSIGNMENT AND SUBLETTING OF CONTRACT

4.1 The contractor may, after informing the engineer and getting his written approval, assign or sub-let the contract or any part thereof other than for raw materials, for minor detail or any part of the plant for which makes are identified in the contract. Suppliers of the equipment not identified in the contract or any change in the identified supplier shall be subject to approval by the engineer. The experience list of the equipment vendors under consideration by the contractor for this contract shall be furnished to the engineer for approval prior to procurement of all such items/equipments. Such assignment sub-letting shall not relieve the contractor from any obligation, duty or responsibility under the contract. Any assignment as above without prior written approval of engineer shall be void.

4.2 For components/equipments procured by the contractors for the purposes of the contract, after obtaining the written approval of the owner, the contractor's purchase specifications and enquiries shall call for quality plans to be submitted by the suppliers along with their proposals. The quality plans called for from the vendors shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection documentation raised, etc. Such quality plans of the successful vendor shall be discussed and finalised in consultation with the engineer and shall form a part of the purchase order/contract between the contractor and the vendor. Within 3 weeks of the release of the same purchase order/contracts for such bought out items/ components, a copy of the same without price details but together with detailed purchase specifications, quality plans and delivery conditions shall be furnished to the engineer by the contractor.
5.0 PATENT RIGHTS AND ROYALTIES

5.1 Royalties and fees for patent covering materials, articles, apparatus, devices, equipment or processes used in the works shall be deemed to have been included in the contract price. The contractor shall satisfy all demands that may be made at any time for such royalties or fees and he alone shall be liable for any damages or claims for patent infringements and shall keep the owner indemnified in that regard. The contractor shall, at his own cost and expense, defend all suits or proceedings that may be instituted for alleged infringement of any patent involved in the works, and, in case of an award of damages, the contractor shall pay for such award. In the event of any suit or other proceedings instituted against the owner, the same shall be defended at the cost and expense of the contractor who shall also satisfy/comply and decree, order or award made against the owner. But it shall be understood that no such machine, plant, work, material or thing has been used by the owner for any purpose or any manner other than that for which they have been furnished and installed by the contractor and specified under these specifications. Final payment to the contractor by the owner will not be made while any such suit or claim remains unsettled. In the event any apparatus or equipment, or any matter thereof furnished by the contractor, is in such suit or proceedings held to constitute infringement, and its use is enjoined, the contractor shall, at his option and at his own expense, either procure for the owner, the right to continue use of said apparatus, equipment or part thereof, replace it with non-infringing apparatus or equipment or modify it, so it becomes non-infringing.

6.0 TIME - THE ESSENCE OF CONTRACT

6.1 The time and the date of completion of the works as stipulated in the contractor's proposal and accepted by the owner without or with modifications, if any and so incorporated in the award letter shall be deemed to be the essence of the contract. The contractor shall so organise his resources and perform his work as to complete it not later than the date agreed to.

6.2 The contractor shall submit a detailed PERT network within the time frame agreed above consisting of adequate number of activities covering various key phases of the works such as design, procurement, manufacturing, shipment and field erection activities within fifteen (15) days after the date of acceptance of tender. This network shall also indicate the interface facilities to be provided by the owner and the dates by which such facilities are needed. Contractor shall discuss the network so submitted with the owner and the agreed network which may be in the form as submitted or in revised form in line with the outcome of discussions and shall form part of the contract to be signed within sixty (60) days from the date of letter of acceptance of notice of award of contract. During the performance of contract, if in the opinion of the engineer proper progress is not maintained suitable changes shall be made in the contractor's operations to ensure proper progress.

6.3 The above PERT network shall be reviewed and periodic review reports shall be submitted by the contractor as directed by the engineer.

6.4 Subsequent to the award of the contract, the contractor shall make available to the engineer, a detailed manufacturing programme, in line with the agreed contract network. Such manufacturing programme shall be reviewed, updated and submitted to the Engineer, once every two month thereafter.
7.0 **CONTRACT PRICE**

7.1 The lump sum prices quoted by the contractor in his bid with additions and deletions as may be agreed before signing of the contract, for the entire scope of the work including furnishing and erection of equipment covered under the specifications and documents and shall be treated as the contract price.

8.0 **CHANGED QUANTITY**

8.1 The owner reserves the right to vary the quantities of items or groups of items to be ordered as specified in the accompanying technical specifications, as may be necessary, during the execution of the contract, but such variations unless otherwise specified in the accompanying technical specifications shall be limited to plus or minus twenty percent (20%) of the original quantity ordered.

9.0 **DEDUCTIONS FROM CONTRACT PRICE**

9.1 All costs, damages or expenses which the owner may have paid, for which under the contract the contractor is liable, will be claimed by the owner. All such claims shall be billed by the owner to the contractor regularly as and when they fall due. Such bills shall be supported by appropriate and certified vouchers or explanations, to enable the contractor to properly identify such claims. Such claims shall be paid by the contractor within fifteen (15) days of the receipt of the corresponding bills and if not paid by the contractor within the said period, the owner may then deduct the amount, from any moneys due or becoming due by him to the contractor under the contract or may be recovered by actions of law or otherwise, if the contractor fails to satisfy the owner of such claims.

10.0 **CONTRACT PRICE ADJUSTMENT**

10.1 All adjustments in the contract price shall be computed in accordance with the conditions and formulae prescribed in the relevant clauses of 'Additional Terms and Conditions of Contract', the accompanying technical specifications and further satisfying the requirements specified herein.

10.2 The contract price stated in the contract agreement is the base price. A certain fixed percentage of the base price as indicated in the technical specifications shall not be subject to any price adjustment. The balance percentage viz. the cost portion shall only be subject to price adjustment.

10.3 Price adjustment shall be applicable to the cost portion, only if changes in the cost of labour and materials (either increases or decreases) occur during the contract period, directly affecting the cost portion.

10.4 Variations in the cost of materials shall be determined by comparing published material indices as of thirty (30) days prior to the date set for opening of bids or the revised price bid, whichever is later, with the same indices published during the manufacture at the respective cut off periods for material as specified in clause 2.0 of Additional Terms and Conditions of Contract. Variations in the cost of labour shall be determined by comparing the wages as per the Minimum Wages Act/ Rules of the State or Central Government, whichever is more, applicable to the place of work as of thirty (30) days prior to the date set for opening of bids or the revised price bid, whichever is later, with the same wages as per the Minimum Wages Act/ Rules of the State or Central Government, whichever is more, during the work/manufacture applicable to the place of work/manufacture at the respective cut off.
10.5 Periods for labour as specified in clause 2.0 of Additional Terms and Conditions of Contract of this volume.

10.6 The total computed variation in the contract price shall be restricted to a limiting percentage as specified in clause 2.5 of Additional Terms and Conditions of Contract of this volume.

10.7 The price adjustment for the erection shall be made on the value of erection work done as indicated in each billing.

10.5 Every three months after the award of contract, and a month prior to shipment of equipment (in the case of ex-factory price component of contract price), and every month after establishing his site office (in the case of erection) the contractor shall submit to the engineer a written notice of the changes, if any, that have occurred in the specified material and labour indices during the previous reporting period containing the effective date of such change, the amount of change, the amount of contract price adjustment and documentary evidence to substantiate the price adjustment.

10.6 The contract price adjustment provisions detailed above, shall only be applicable if so specified in the Additional Terms and Conditions of Contract.

11.0 PACKING, FORWARDING AND SHIPMENT

11.1 The contractor, wherever applicable, shall after proper painting, pack and crate all equipment in such a manner as to protect them from deterioration and damage during rail and road transportation to the site and storage at the site till the time of erection. The contractor shall be held responsible for all damages due to improper packing.

11.2 The contractor shall notify the owner of the date of each shipment from his works, and the expected date of arrival at the site for the information of the owner.

11.3 The contractor shall also give all shipping information concerning the weight, size and content of each packing including any other information the owner may require.

11.4 The following documents shall be sent by registered post to the owner within 3 days from the date of shipment, to enable the owner to make progressive payments to the contractor:

- Application for payment in the standard format of the owner (3 copies)
- Invoice (6 copies)
- Packing list (6 copies)
- Pre-despatch clearance certificate, if any (3 copies)
- Test certificate, wherever applicable (3 copies)

11.5 The contractor shall prepare detailed packing list of all packages and containers, bundles and loose material forming each and every consignment dispatched to site. The contractor shall further be responsible for making all necessary arrangements for loading, unloading and other handling right from his works up to the site and also till the equipment is erected, tested and commissioned. He shall be solely responsible for proper storage and safe custody of all equipment.
12.0 DEMURRAGE, WHARFAGE, ETC.
12.1 All demurrage, wharfage and other expenses incurred due to delayed clearance of the material or any other reason shall be to the account of the contractor.

13.0 INSURANCE
13.1 The contractor shall arrange, secure and maintain insurance as may be necessary and for all such amounts to protect his interests and the interests of the owner, against all risks as detailed herein in the joint names of the Owner and the Contractor with the condition that payments against all claims shall be payable by insurers to the owner as elaborated at clause 13.5. All premiums and other charges of the said insurance policies shall be paid by the contractor. The form and the limit of such insurance, as defined herein together with the under-writer thereof in each case shall be acceptable to the owner. However, irrespective of such acceptance, the responsibility to maintain adequate insurance coverage on comprehensive all risks basis at all time during the period of contract shall be that of the contractor alone. The contractor's failure in this regard shall not relieve him of any of his contractual responsibilities and obligations.

13.2 Any loss of damage to the equipment, during handling, transporting, storage and erection, till such time the plant is taken over by the owner, shall be to the account of the contractor. The contractor shall be responsible for preferring of all claims and make good for the damage or loss by way of repairs and/or replacement of the portion of the works damaged or lost. The transfer of title shall not in any way relieve the contractor of the above responsibilities during the period of the contract. The contractor shall provide the owner with a copy of all insurance policies and documents taken out by him in pursuance of the contract. Such copies of document shall be submitted to the owner immediately after such insurance coverage. The contractor shall also inform the owner in writing at least sixty (60) days in advance, regarding the expiry, cancellation and/or change in any of such documents and ensure revalidation/renewal, etc. as may be necessary well in time.

13.3 The risk that are to be covered under the insurance shall include, but not be limited to, the loss or damage in transit, theft, pilferage, riot, civil commotion, weather conditions, accidents of all kinds, fire, etc. The scope of such insurance shall cover the entire value of the works from time to time.

13.4 All costs on account of insurance liabilities covered under the contract will be on contractor's account and will be included in contract price. However, the owner may from time to time, during the pendancy of the contract, ask the contractor in writing to limit the insurance coverage risks and in such a case, the parties to the contract will agree for a mutual settlement for reduction in contract price to the extent of reduced premium amounts.

13.5 All insurance claims, payable by the insurers, shall be paid to the Owner which shall be released to the contractor in installments as may be certified by the Engineer-in-charge for the purpose of rebuilding or replacement or repair of the works and/or goods destroyed or damaged for which payment was received from the insurers.
13.6 The clause entitled insurance under the section erection terms and conditions of contract of this volume, covers the additional insurance requirements for the portion of the works to be performed at the site of work.

14.0 LIABILITY FOR ACCIDENTS AND DAMAGES

14.1 Under the contract, the contractor shall be responsible for loss or damage to the plant until the plant is taken over in accordance with clause entitled 'Taking Over' in section technical terms and conditions of contract of this volume.

15.0 LIQUIDATED DAMAGES FOR DELAY IN COMPLETION

15.1 If the contractor fails to maintain the required progress in terms of the agreed time and progress chart or to complete the work and clear the site on or before the contract or extended date of completion, he shall pay as agreed compensation/liquidated damages @ half percent (1/2 %) of the contract price per week of delay. The aggregate of such compensation/compensations shall not exceed 10 (ten) percent of the total value as shown in contract. This will also apply to items or group of items for which separate period of completion has been specified. The amount of compensation may be adjusted or setoff against any sum payable to the contractor under this or any other contract with the company.

15.1.1 The company, if satisfied, that the works can be completed by the contractor within a reasonable time after the specified time of completion, may allow further extension of time at its discretion with or without the levy of L.D. In the event of extension granted being with L.D., the company will be entitled without prejudice to any other right or remedy available in that behalf, to recover from the contractor as agreed damages equivalent to half percent of the contract value of the works for each week or part of the week subject to a ceiling of 10% of the contract price.

The company, if not satisfied, that the works can be completed by the contractor, and in the event of failure on the part of the contractor to complete work within the further extension of time allowed as aforesaid, shall be entitled, without prejudice to any other right or remedy available in that behalf, to rescind the contract.

15.1.2 The company, if not satisfied with the progress of the contract and in the event of failure of the contract to recoup the delays in the mutually agreed time frame, shall be entitled to terminate the contract.

15.1.3 In the event of such termination of the contract as described in clause 15.1.2 or 15.1.1 or both, the company, shall be entitled to recover L.D. up to (10%) of the contract value and forfeit the security deposit made by the contractor besides getting the work completed by other means at the risk and cost of the contractor.

15.2 The company may, waive the payment of compensation, depending upon merit of the case, on request received from the contractor if the entire work is completed within the date as specified in the contract or as validly extended without stipulating any penalty.
16.0 CONTRACTOR'S DEFAULT

16.1 If the contractor shall neglect to execute the works with the diligence and expedition or shall refuse or neglect to comply with any reasonable orders given to him, if writing by the engineer in connection with the works or shall contravene the provisions of the contract, the owner may give notice in writing to the contractor to make good the failure, neglect or contravention complained of. Should the contractor fail to comply with the notice within thirty (30) days from the date of service thereof, then and in such case the owner shall be at liberty to employ other workmen and forthwith execute such part of the works as the contractor may have neglected to do or if the owner shall think fit, it shall be lawful for him, without prejudice to any other right he may have under the contract, to take the works wholly or in part thereof and in that event the owner shall have free use of all contractor's equipment that may have been at the time on the site in connection with the works without being responsible to the contractor for fair wear and tear thereof and to the exclusion of any right of the contractor over the same, and the owner shall be entitled to retain and apply any balance which may otherwise be due on the contract by him to the contractor, or such part thereof as may be necessary, the payment of the cost of executing the said part of the works or of completing the works as the case may be. If the cost of completing the works or executing a part thereof as aforesaid shall exceed the balance due to the contractor, the contractor shall pay such excess. Such payment of excess amount shall be independent of the liquidated damages for delay which the contractor shall have to pay if the completion of works is delayed.

16.2 In addition, such action by the owner as aforesaid shall not relieve the contractor of his liability to pay liquidated damages for delay in completion of works as defined in clause 15.0 of this section.

16.3 The termination of the contract under this clause shall not entitle the contractor to reduce the value of the performance bank guarantee nor the time thereof. The performance guarantee shall be valid for the full value and for the full period of the contract including guarantee period.

16.4 The bidding documents will clearly state that:

(a) The successful bidder will advise, in the event of his having resort to this clause by a registered letter duly certified by the local chamber of commerce or statutory authorities, the beginning and end of the clause of delay, within fifteen days of the occurrence and cessation of such Force Majeure condition. In the event of delay lasting over two months, if arising out of Force Majeure, the contract may be terminated at the discretion of the company.
(b) For delays arising out of Force Majeure, the bidder will not claim extension in completion date for a period exceeding the period of delay attributable to the causes of Force Majeure and neither company nor the bidder shall be liable to pay extra costs (like increase in rates, remobilisation advance, idle charges for labour and machinery etc.) Provided it is mutually established that the Force Majeure conditions did actually exist.

(c) If any of the Force Majeure conditions exists in the place of operation of the bidder even at the time of submission of bid he will categorically specify them in his bid and state whether they have been taken into consideration in their quotations.

17.3 The contractor or the owner shall not be liable for delays in performing his obligations resulting from any Force Majeure cause as referred to and/or defined above. The date of completion will, subject to hereinafter provided, be extended by a reasonable time even though such cause may occur after contractor's performance of his obligations has been delayed for other causes.

18.0 DELAYS BY OWNER OR HIS AUTHORISED AGENT

18.1 In case the contractor's performance is delayed due to any act of omission on the part of the owner or his authorised agents, then the contractor shall be given due extension of time for the completion of the works, to the extent such omission on the part of the owner has caused delay in the contractor's performance of his work. Regarding reasonableness or otherwise of the extension of time, the decision of the engineer shall be final.

18.2 In addition, the contractor shall be entitled to claim demonstrable and reasonable compensation if such delays have resulted in any increase in the cost of work. The owner shall examine the justification for such a request for claim, and if satisfied, the extent of compensation shall be mutually agreed depending upon the circumstances at the time of such an occurrence.

18.3 Any delay in finalization of mutual agreement in regard to any of the contractor's claim/compensation against any act of omission on the part of the owners or his authorised agents should not result in any work stoppage/further delay on the part of the contractor.

19.0 EXTENSION OF DATE OF COMPLETION

19.1 On happening of any events causing delay as stated hereinafter, the contractor shall intimate immediately in writing the Engineer-in-Charge:
   a. due to any reasons defined as Force Majeure.
   b. non-availability of stores which are the responsibility of the owner to supply
   c. non-availability or breakdown of tools and plant to be made available or made available by the owner
   d. delay on the part of the contractors or tradesmen engaged by the owner not forming part of the contract, holding up further progress of the work
   e. non-availability of working drawings/work programme in time, which are to be made available by the company during progress of the work
   f. any other causes which, at the sole discretion of the company, is beyond the control of the contractor.

19.2 A "Hindrance Register" shall be maintained by both the Company and the Contractor at site to record the various hindrances, as mentioned above, encountered during the course of execution.
19.3 The contractor may request the company in writing for extension of time within 14 days of happening of such event causing delay stating also, if practicable, the period for which extension is desired. The company may, considering the eligibility of the request, give a fair and reasonable extension of time for completion of the work. Such extension shall be communicated to the contractor in writing by the company through the Engineer-in-charge within 1 month of the date of receipt of such request. The contractor shall however use his best efforts to prevent or make good the delay by putting his endeavours constantly as may be reasonably required of him to the satisfaction of the Engineer-in-charge.

19.4 Provisional extension of time may also be granted by the Engineer -In-charge during the course of execution, on written request for extension of time within 15 (fifteen) days of happening of such events as stated above, reserving the company's right to impose/ waive liquidated damages at the time of granting final extension of time as per contract agreement.

19.5 When the period fixed for the completion of the contract is about to expire, the question of extension of the contract may be considered at the instance of the Contractor or the Company or the both. The extension will have to be by party's agreement, expressed or implied.

19.6 In case the Contractor does not apply for grant of extension of time within 15 (fifteen) days of hindrance occurring in execution of the work and the Company wants to continue with the work beyond the stipulated date of completion for reason of the work having been hindered, the Engineer-in-charge at his sole discretion can grant provisional extension of time even in the absence of application from the Contractor. Such extension of time granted by the Engineer-in-charge is valid provided the Contractor accepts the same either expressly or implied by his actions before and subsequent to the date of completion. Such extension of time shall be without prejudice to Company's right to levy compensation under the relevant clause of contract.

20.0 TERMINATION, SUSPENSION, CANCELLATION & FOR ECLOSURE OF CONTRACT

20.1 The owner shall, in addition to other remedial steps to be taken as provided in the conditions of contract, be entitled to cancel the contract in full or in part, if the contractor

a. makes default in proceeding with the works with due diligence and continues to do so even after a notice in writing from the Engineer-in-charge, then on the expiry of the period as specified in the notice

OR

b. commits default/breach in complying with any of the terms and conditions of the contract and does not remedy it or fails to take effective steps for the remedy to the satisfaction of the Engineer-in-charge, then on the expiry of the period as may be specified by the Engineer-in-charge in a notice in writing

OR

c. fails to complete the work or items of work with individual dates of completion, on or before the date/dates of completion or as extended by the company, then on the expiry of the period as may be specified by the Engineer-in-charge in a notice in writing

OR

d. shall offer or give or agree to give any person in the service of the company or to any other person on his behalf any gift or consideration of any kind as an inducement or reward for act/acts of favour in relation to the obtaining or execution of this or any other contract for the company.
or

e. shall try to obtain a contract with the company by way of of ring tendering or other non-bonafide method of competitive tendering.

OR

f. transfers, sublets, assigns the entire work or any portion there of without the prior approval in writing from the Engineer-in-charge. The Engineer-in-charge may by giving a written notice, cancel the whole contract or portion of it in default.

20.2 The owner shall in such an event give fifteen (15) days notice in writing to the contractor of his decision to do so.

The contractor upon receipt of such notice shall discontinue the work on the date and to the extent specified in the notice, make all reasonable efforts to obtain cancellation of all orders and contracts to the extent they are related to the work terminated and terms satisfactory to the owner, stop all further sub-contracting or purchasing activity related to the work terminated, and assist the owner in maintenance, protection, and disposition of the works acquired under the contract by the owner.

20.3 In the event of such a termination, the contractor shall be paid compensation, equitable and reasonable dictated by the circumstances prevalent at the time of termination.

20.4 The contract shall stand terminated under the following circumstances unless the owner is satisfied that the legal representatives of the individual contractor or of the proprietor of the proprietary concern and in the case of partnership the surviving partners, are capable of carrying out and completing the contract and the owner shall in any way not be liable to payment of any compensation to the estate of deceased contractor and/or to the surviving partners of the contractor's firm on account of the termination of the contract:

a. If the contractor being an individual in the case of proprietary concern or in the case of a partnership firm any of its partners is declared insolvent under the provisions of insolvency act for the time being in force, or makes any conveyance or assignment of his effects or composition or arrangement for the benefit of his creditors amounting to proceedings for liquidation or composition under any insolvency act.

b. In the case of the contractor being a company, its affairs are under liquidation either by a resolution passed by the company or by an order of court, not being a voluntary liquidation proceedings for the purpose of amalgamation or reorganisation, or a receiver or manager is appointed by the court on the application by the debenture holders of the company, if any.

c. If the contractor shall suffer an execution being levied on his/their goods, estates and allow it to be continued for a period of 21 days.
d. On the death of the contractor being a proprietary concern or of any of the partners in the case of a partnership concern and the company is not satisfied that the legal representative of the deceased proprietor or the other surviving partners of the partnership concern are capable of carrying out and completing the contract. The decision of the company in this respect shall be final and binding which is to be intimated in writing to the legal representative or to the partnership concern.

20.5 If the contractor is an individual or a proprietary concern and the individual or the proprietor dies and if the contractor is a partnership concern and one of the partners dies, then unless the owner is satisfied that the legal representatives of the individual contractor or of the proprietor of the proprietary concern and in the case of partnership the surviving partners, are capable of carrying out and completing the contract the owner shall be entitled to cancel the contract as to its incomplete part without being in any way liable to payment of any compensation to the estate of deceased contractor and/or to the surviving partners of the contractor's firm on account of the cancellation of the contract.

The decision of the owner that the legal representatives of the deceased contractor or surviving partners of the contractor's firm cannot carry out and complete the contract shall be final and binding on the parties. In the event of such cancellation the owner shall not hold the estate of the deceased contractor and/or the surviving partners of the estate of the deceased contractor and/or the surviving partners of the contractor's firm liable to damages for not completing the contract.

20.6 On cancellation of the contract or on termination of the contract, the Engineer-in-charge shall have powers

a. to take possession of the site and any materials, constructional plant, implements, stores, etc. thereon.

b. to carry out the incomplete work by any means at the risk of the contractor

c. to determine the amount to be recovered from the contractor for completing the remaining work or in the event the remaining work is not to be completed the loss/damage suffered, if any, by the company after giving credit for the value of the work executed by the contractor up to the time of termination/cancellation less on a/c payments made till date and value of contractor's materials, plant, equipment, etc., taken possession of after termination/cancellation.

d. to recover the amount determined as above, if any, from any moneys due to the contractor or any account or under any other contract and in the event of any shortfall, the contractor shall be called upon to pay the same on demand.

The need for determination of the amount of recovery of any extra cost/ expenditure or of any loss/ damage suffered by the company shall not however arise in the case of termination of the contract for death/demise of the contractor as stated in 20.4(d).
20.7 Suspension of work - The company shall have power to suspend the progress of the work or any part thereof and the Engineer-in-charge may direct the contractor in writing to suspend the work, for such period and in such manner as may be specified therein, on account of any default on the part of the contractor, or for proper execution of the work for reasons other than any default on the part of the contractor, or on ground of safety of the work or part thereof. In the event of suspension for reason other than any default on the part of the contractor, extension of time shall be allowed by the company equal to the period of such suspension. Any necessary and demonstrable costs incurred by the contractor as a result of such suspension of the works will be paid by the owner, provided such costs are substantiated to the satisfaction of the engineer. The owner shall not be responsible for any liabilities if suspension or delay is due to some default on the part of the contractor or his sub contractor.

The work shall, throughout the stipulated period of contract, be carried out with all due diligence on the part of the contractor. In the event of termination or suspension of the contract, on account of default on the part of the contractor, as narrated hereinbefore, the security deposit and other dues of his work or any other work done under this company shall be forfeited and brought under the absolute disposal of the company provided, that the amount so forfeited shall not exceed 10% of the contract value.

20.8 Foreclosure of contract in full or in part - If at any time after acceptance of the tender, the company decides to abandon or reduce the scope of the work for any reason whatsoever the company, through its Engineer-in-charge, shall give notice in writing to that effect to the contractor. In the event of abandonment/reduction in the scope of work, the company shall be liable

a. to pay the contractor at the contract rates full amount for works executed and measured at site up to the date of such abandonment/reduction in the work.

b. to pay reasonable amount assessed and certified by the Engineer-in-charge of the expenditure incurred, if any, by the contractor on preliminary works at site. e.g. temporary access roads, temporary construction for labour and staff quarters, office accommodation, storage of materials, water storage tanks and supply for the work including supply to labour/staff quarters, office, etc.

c. to pay for the materials brought to site or to be delivered at site, which the contractor is legally liable to pay, for the purpose of consumption in works carried out or were to be carried out but for the foreclosure, including the cost of purchase and transportation and cost of delivery of such materials. The materials to be taken over by the company should be in good condition and the company may allow at its discretion the contractor to retain the materials in full or part if so desired by him and to be transported by the contractor from site to his place.

d. to take back the materials issued by the company but remaining unused, if any, in the work on the date of abandonment/reduction in the work, at the original issued price less allowance for any deterioration or damage caused while in custody of the contractor

e. to pay for the transportation of tools and plants of the contractor from site to contractor's place or to any other destination, whichever is less.

The contractor shall, if required by the Engineer-in-charge, furnish to him books of accounts, papers, relevant documents as may be necessary to enable the Engineer-in-charge to assess the amount payable in terms of part 20.8(b), (c) and (e) above, the contractor shall not have any claim for compensation whatsoever either for abandonment or for reduction in the scope of work, other than those as specified above.
21.0 NO WAIVER OF RIGHTS

Neither the inspection by the owner or the engineer or any of their officials, employees or agents nor any order by the owner or the engineer for payment of money or any payment for or acceptance of, the whole or any part of the works by the owner or the engineer, nor any extension of time, nor any possession taken by the engineer shall operate as a waiver of any provision of the contract, or of any power herein reserved to the owner, or any right to damages herein provided, nor shall any waiver of any breach in the contract be held to be a waiver of any other or subsequent breach.

22.0 CERTIFICATE NOT TO AFFECT RIGHT OF OWNER AND LIABILITY OF CONTRACTOR

No interim payment certificate of the engineer, nor any sum paid on account, by the owner, nor any extension of time for execution of the works granted by the engineer shall affect or prejudice the rights of the owner against the contractor or relieve the contractor of his obligations for the due performance of the contract, or be interpreted as approval of the works done or of the equipment furnished and no certificate shall create liability for the owner to pay for alterations, amendments, variations or additional works not ordered, in writing, by the engineer or discharge the liability of the contractor for the payment of damages whether due, ascertained, or certified or not, or any sum against the payment of which he is bound to indemnify the owner, nor shall any such certificate nor the acceptance by him of any sum paid on account or otherwise affect the liabilities of the rights of the contractor against the owner.

23.0 GRAFTS AND COMMISSIONS ETC.

Any graft, commission, gift or advantage given, promised or offered by or on behalf of the contractor or his partner, agent, officers, director, employee or servant or any one of his or their behalf in relation to the obtaining or to the execution of this or any other contract with the owner, shall, in addition to any criminal liability which it may incur, subject the contractor to the cancellation of this and all other contracts and also to payment of any loss or damage to the owner resulting from any cancellation. The owner shall then be entitled to deduct the amount so payable from any moneys otherwise due to the contractor under the contract.

24.0 LANGUAGE AND MEASURES

All documents pertaining to the contract including specifications, schedules notices, correspondence, operating and maintenance instructions, drawings or any other writing shall be written in English language. The metric system of measurement shall be used exclusively in the contract.

25.0 RELEASE OF INFORMATION

The contractor shall not communicate or use in advertising, publicity, sales releases or in any other medium photographs or other reproduction of the works under this contract, or descriptions of the site, dimensions, quantity, quality or other information, concerning the works unless prior written permission has been obtained from the owner.

26.0 CONSTRUCTION OF THE CONTRACT

26.1 Notwithstanding anything stated elsewhere in the bid documents, the contract to be entered into will be treated as a divisible supply and erection contract. The supply portion of the contract will relate to the supply of equipment and materials and the erection portion will relate to the handling at the site, storage, erection, construction, testing, commissioning etc. as defined in the bid documents. Both contracts will contain a cross breach clause specifying that breach of any one contract will also constitute breach of the other contract and the whole contract combined. The contractor will pay the sales tax for the supply of equipment and materials in accordance with law and the same will be reimbursed by the owner as a part of the total contract price on actuals. The sales tax should be included in the total bid price in the proposal and should also be indicated separately.
26.2 In case of divisible supply and erection contract, or where the owner hands over his equipment to the contractor for executing, then the contractor shall at the time of taking delivery of the equipment/despatch documents be required to execute an indemnity bond in favour of the owner in the form acceptable to the owner for keeping the equipment in safe custody and to utilise the same exclusively for the purposes of the said contract.

26.3 The contract shall in all respects be construed and governed accordingly to Indian Laws.

26.4 It is clearly understood that the total consideration for the contract(s) has been broken up into various components only for the convenience of payment of advance under the contract(s) and for the measurement of deviations or modifications under the contract(s).

27.0 COMPLETION OF CONTRACT

Unless otherwise terminated under the provisions of any other relevant clause, this contract shall be deemed to have been completed at the expiration of the guarantee period as provided for under the clause entitled 'Guarantee' in this section.

28.0 ENFORCEMENT OF TERMS

The failure of either party to enforce at any time of the provisions of this contract or any rights in respect thereto or to exercise any option herein provided, shall in no way be construed to be a waiver of such provisions, rights or options or in any way to affect the validity of the contract. The exercise by either party of any of its rights herein shall not preclude or prejudice either party from exercising the same or any other right it may have hereunder.

29.0 ENGINEER'S DECISION

29.1 In respect of all matters which are left to the decision of the engineer including the granting or withholding of the certificates, the engineer shall, if required to do so by the contractor give in writing a decision thereon.

29.2 If in the opinion of the contractor, a decision made by the engineer is not in accordance with the meaning and intent of the contract, the contractor may file with the engineer within fifteen (15) days after receipt of the decision, a written objection to the decision. Failure to file an objection within the allotted time will be considered as acceptance of the engineer's decision and the decision shall become final and binding.

29.3 The engineer's decision and the filling of the written objection thereto shall be a condition precedent to the right to any legal proceedings. It is the intent of the agreement that there shall be no delay in the execution of the works and the decision of the engineer as rendered shall be promptly observed.

30.0 CO-OPERATION WITH OTHER CONTRACTORS AND CONSULTING ENGINEERS

The contractor shall agree to co-operate with the owner's other contractors and consulting engineers and freely exchange with them such technical information as is necessary to obtain the most efficient and economical design and to avoid unnecessary duplication of efforts. The engineer shall be provided with three copies of all correspondence addressed by the contractor to other sub-contractors and consulting engineers in respect of such exchange of technical information,
31.0  TRAINING OF OWNER'S PERSONNEL

31.1  The contractor shall undertake to train free of cost, engineering personnel selected and sent by the owner at the works of the contractor unless otherwise specified in the technical specifications. The period and the nature of training for the individual personnel shall be agreed upon mutually between the contractor and the owner. These engineering personnel shall be given special training in the shops, where the equipment will be manufactured and/or their collaborator's works and where possible, in any other plant where equipment manufactured by the contractor or his collaborator is under installation or test, to enable those personnel to become familiar with the equipment being furnished by the contractor.

31.2  All travelling and living expenses for the engineering personnel to be trained during the total period of training will be borne by the owner. These engineering personnel while undergoing training shall be responsible to the contractor for discipline.

31.3  In the event of the owner, for any reason, failing to avail of the training facilities, he shall not be entitled for any rebate whatsoever on this account.

32.0  POWER TO VARY OR OMIT WORK

32.1  No alterations, amendments, omissions, suspensions or variations of the works (hereinafter referred to as 'Variation') under the contract as detailed in the contract documents, shall be made by the contractor except as directed in writing by the engineer, but the engineer shall have full power subject to the provision hereinafter contained from time to time during the execution of the contract, by notice in writing, to instruct the contractor to make such variation without prejudice to the contract. The contractor shall carry out such variation and be bound by the same conditions as far as applicable as though the said variation occurred in the contract documents. If any suggested variation would, in the opinion of the contractor, if carried out, prevent him from fulfilling any of his obligations or guarantees under the contract, he shall notify the engineer there of in writing and the engineer shall decide forthwith, whether or not the same shall be carried out and if the engineer confirm his instructions, contractor's obligations and guarantees shall be modified to such an extent as may be mutually agreed. Any agreed difference in cost occasioned by any such variation shall be added to or deducted from the contract price as the case may be.

32.2  In the event of the engineer requiring any variation, such reasonable and proper notice shall be given to the contractor to enable him to work his arrangements accordingly, and in cases where goods or materials are already prepared or any design, drawings of pattern made or work done requires to be altered, a reasonable and agreed sum in respect there of shall be paid to the contractor.

32.3  In any case in which the contractor has received instructions from the engineer as to the requirement of carrying out the altered or additional substituted work which either then or later on, will in the opinion of the contractor, involve a claim for additional payments, the contractor shall immediately and in no case later than thirty (30) days, after receipt of the instructions aforesaid and before carrying out the instructions, advise the engineer to that effect. But the engineer shall not become liable for the payment of any charges in respect of any such variations, unless the instructions for the performance of the same shall be confirmed in writing by the engineer.

32.4  If any variation in the works, results in reduction of contract price, the parties shall, agree, in writing, so to the extent of any change in the price, before in contractor proceeds with the change.

32.5  In all the above cases, in the event of a disagreement as to the reasonableness of the said sum, the decision of the engineer shall prevail.

32.6  Notwithstanding anything stated above in this clause, the engineer shall have the full power to instruct the contractor, in writing, during the execution of the contract, to vary to quantities of the items or groups of items. The contractor shall carry out such variations and be bound by the same conditions, as though the said variations occurred in the contract documents. However, the contract price shall be adjusted at the rates and the prices provided for the original quantities in the contract.
33.0 GUARANTEE

33.1 The contractor shall warrant that the equipment will be new and in accordance with the contract documents and be free from defects in material and workmanship for a period of twelve (12) calendar months commencing immediately upon the satisfactory completion of the trial operations. The contractor's liability shall be limited to the replacement of any defective parts in the equipment of his own manufacture of those of his sub-contractors, under normal use and arising solely from faulty design, materials, and/or workmanship provided always that such defective parts are repairable at the site and are not in the meantime essential in the commercial use of the plant. Such replaced defective parts shall be returned to the contractor unless otherwise arranged. No repairs or replacements shall normally be carried out by the engineer when the plant is under the supervision of the contractor's supervisory engineers.

34.0 REPLACEMENT OF DEFECTIVE PARTS AND MATERIALS

34.1 If during the progress of the works the engineer shall decide and inform in writing to the contractor, that the contractor has manufactured any plant or part of the plant unsound or imperfect or has furnished any plant inferior than the quality specified, the contractor on receiving details of such defects or deficiencies shall at his own expense within seven (7) days of his receiving the notice, or otherwise, within such time as may be reasonably necessary for making it good, proceed to alter, re-construct or remove such work and furnish fresh equipment up to the standards of the specifications. In case the contractor fails to do so, the engineer may on giving the contractor seven (7) days' notice in writing of his intentions to do so, proceed to remove the portion of the works so complained of and, at the cost of the contractor, perform all such work or furnish all such equipment provided that nothing in this clause shall be deemed to deprive the owner of or affect any rights under the contract which the owner may otherwise have in respect of such defects and deficiencies.

34.2 The contractor's full and extreme liability under this clause shall be satisfied by the payments to the owner of the extra cost, of such replacement procured, including erection, as provided for in the contract, such extra cost being the ascertained difference between the price paid by the owner for such replacements and the contract price portion for such defective plant and repayments of any sum paid by the owner to the contractor in respect of such defective plant. Should the owner not so replace the defective plant, the contractor's extreme liability under this clause shall be limited to repayment of all sums paid by the owner under the contract for such defective plant.

35.0 DEFENCE OF SUITS

If any action in court is brought against the owner or engineer or an officer or agent of the owner, for the failure or neglect on the part of the contractor to perform any acts, matters, covenants or things under the contract, or for damage or injury caused by the alleged omission or negligence on the part of the contractor, his agents, representatives or his subcontractors, workmen, suppliers or employees, the contractor shall in all such cases indemnify and keep the owner, and the engineer and/or his representative, harmless from all losses, damages, expenses or decrees arising of such action.

36.0 LIMITATIONS OF LIABILITIES

The final payment by the owner in pursuance of the contract shall mean, the release of the contractor from all his liabilities under the contract. Such final payment shall be made only at the end of the guarantee period as detailed in clause 33 above and till such time as the contractual liabilities and responsibilities of the contractor, shall prevail. All other payments made under the contract shall be treated as on account payments.

37.0 MARGINAL NOTES

The marginal notes to any clause of the contract shall not affect or control the construction of such clause.
38.0 TAXES, PERMITS & LICENCES

The contractor shall be liable and pay all Indian taxes, duties, levies, lawfully assessed against the owner or the contractor in pursuance of the contract. In addition the contractor shall be responsible for payment of all Indian duties, levies and taxes lawfully assessed against the contractor for his personal income and property only. This clause shall be read in conjunction with clause 12.3 of section Instruction to Bidders.
39.0 PROGRESS REPORTS AND PHOTOGRAPHS

During the various stages of the works in the pursuance of the contract, the contractor shall at his own cost submit periodic progress reports as may be reasonably required by the engineer with such materials as charts, net-works, photographs, test certificates, etc. such progress report shall be in the form and size as may be required by the engineer and shall be submitted in at least three (3) copies.

40.0 LONG TERM AVAILABILITY OF SPARES

40.1 The contractor shall guarantee the long term availability of spares to the owner for the full life of the equipments covered under the contract. The contractor shall guarantee that before going out of production of spare parts of the equipment covered under the contract, he shall give the owner at least twelve (12) months advance notice so that the latter may order his bulk requirement of spares, if he so desires. The same provision will also be applicable to sub-contractor. Further, in case of discontinuance of manufacture of any spares by the contractor or his sub-contractors the contractor will provide the owner two years in advance, with full manufacturing drawings, material specifications and technical information required by the owner for the purpose of manufacture of such items.

40.2 Further, in case of discontinuance of supply of spares by the contractor or his sub-contractors the contractor will provide the owner with full information for replacement of such spares with other equivalent makes, if so required by the owner.

40.3 The contractor shall provide the owner with a "directory" of his sub-contractors giving the addresses and other particulars of his sub-contractors. The owner, if he so desires, shall have the right to procure the spares directly from sub-contractors.

40.4 Notwithstanding anything stated elsewhere in the bid documents, the prices of all spares which may be procured to cover long term requirements beyond the 2 years' maintenance and operational requirements, will be generally in accordance with the mutually agreed prices.

40.5 The contractor will indicate in advance the delivery period of the items of spares, which the owner may procure in accordance with the sub-clause 40.4. In case of emergency requirements of spares, the contractor would make every effort to expedite the manufacture and delivery of such spares on the basis of mutually agreed time schedule.

40.6 The procedure specified in clause 40.4 and 40.5 shall apply for future procurement of items included in stand by spare list, mandatory spares lists, optional spares list and special tools, plants and equipment list, if any, specified in the bid documents.

40.7 The Contractor shall indemnify the owner for the availability of long time spares as per the terms and conditions laid down above in clause 40.1 to clause 40.6.

41.0 PAYMENT

41.1 The payment to the contractor for the performance of the works under the contract will be made by the owner as per the guidelines and conditions specified herein. All payment made during the contract shall be on account payments only. The final payment will be made on completion of all the works and on fulfillment by the contractor of all his liabilities under the contract.
41.2 CURRENCY OF PAYMENT

All payments under the contract shall be in Indian Rupees only.

41.3 DUE DATES FOR PAYMENT

Owner will make progressive payment as and when the payment is due as per the terms of payment set forth in the accompanying technical specifications. Payment will become due and payable by the owner within thirty (30) days from the date of receipt of contractor's bill/invoice/debit note by the owner, provided the documents submitted are complete in all respects.

41.4 PAYMENT SCHEDULE

The contractor shall prepare and submit to the engineer for approval, a break-up of the contract price. This contract price break-up shall be interlinked with the agreed detailed PERT network of the contractor setting forth his starting and completion dates for the various key phases of works prepared as per condition of this section. Any payment under the contract shall be made only after the contractor's price break-up is approved by the engineer. The aggregate sum of the contractor's price break-up shall be equal to the lump sum contract price.

41.5 APPLICATION FOR PAYMENTS

41.5.1 The contractor shall submit application for the payment in the prescribed proforma of the owner. Proforma for application for payment is enclosed in section-6.

41.5.2 Each such application shall state the amount claimed and shall set forth in detail, in the order of the payment schedule, particulars of the works including the works executed at site and of the equipment shipped/brought on to the site pursuant to the contract up to the date mentioned in the application and for the period covered since the last preceding certificate, if any.

41.5.3 Every interim payment certificate shall certify the contract value of the works executed up to the date mentioned in the application for the payment certificate, provided that no sum shall be included in any interim payment certificate in respect of the works that, according to the decision of the engineer, does not comply with the contract, or has been performed, at the date of certificate prematurely.

41.6 MODE OF PAYMENT

The payments due on receipt of equipment and materials, and those for the inland transportation and the erection portion of the works shall be made direct to the contractor by the owner.

41.7 TERMS OF PAYMENTS

41.7.1 The terms of payment for the price components of the equipment and its erection are detailed herein for each equipment package. A certain percentage of the equipment and erection costs, for each package shall be paid as initial advance on fulfillment of the following, by the contractor:

i) FOR THE PRICE-COMPONENT OF EQUIPMENT

a) Issue of letter of acceptance of tender
b) Submission of an unconditional Bank Guarantee covering the advance amount which shall be initially kept valid till expiry of the month after the schedule date for successful completion of trial operations. The proforma of Bank Guarantee for advance is enclosed in section 6. The value of Bank Guarantee (other security) for advance shall be allowed to be reduced every six months after first running account bill/stage payment under the contract, if the value of such B.G (Security) is more than Rs. five hundred thousand (500,000) and validity is more than one year. The cumulative amount of reduction at any point of time shall not exceed 75% of the advance corresponding to cumulative value of supplies/work completed as per a certificate to be issued by the engineer-in-charge. It should be clearly understood that the reduction in the value of advance bank guarantee or other security as above shall not in any way dilute the contractor's responsibilities and liabilities under the contract including in respect of supplies/work for which the reduction in the value of bank guarantee (or other security) is allowed.

c) Submission of an unconditional Bank Guarantee towards contract performance guarantee valid up to ninety (90) days after the end of the guarantee period, in accordance with Clause 3.0.

d) Submission of a detailed PERT network based on the work-schedule stipulated in the letter of award and its approval by owner.

ii) FOR THE ERECTION PRICE-COMPONENT

a) On establishment of his office at site preparatory to mobilisation of his erection establishment.

b) Submission of an unconditional bank guarantee for an equivalent amount, which shall be initially kept valid till expiry of the month after the schedule date for successful completion of trial operations. The proforma of bank guarantee for advance is enclosed in section 6.

c) Signing of contract agreement.

41.7.2 All further payments (refer to clause no. : 41.7.4 of this Section) under the contract shall be made as stipulated in the technical specifications after signing the contract agreement. The payments linked with despatch of materials shall only be made after production of all despatch documents as specified in L/C conditions and/or in the relevant contract conditions which will inter-alia include the material despatch clearance certificate issued by the owner. In case of erection, progress payments shall only be made after the issue of certificates by the engineer's field quality surveillance representative for the successful completion of quality check points involved in the quantum of work billed.

41.7.3 INLAND TRANSPORTATION & INSURANCE

Inland transportation (including port handling) and inland insurance charges shall be paid to the contractor on pro-rata to the value of the equipment received at site and on production of the invoices by the contractor. However, wherever equipment wise inland transportation charges have been called for in the bid proposal sheets and have been furnished by the contractor, the payment of inland transportation charges shall be made after receipt of equipment at site based on the charges thus identified by the contractor in his proposal and incorporated in the contract. The aggregate of all such pro-rata payments shall however, not exceed the total amount quoted by the bidder in his bid and incorporated in the contract.

41.7.4 Payment : Since the total job is on turn-key basis, any payment to the Contractor before the final payment shall be treated as provisional payment towards the total contract value.
The Contractor may at intervals of not less than one month submit claims/bills for payment on account of work done after proper scrutiny and certification of the same by the Employer. The progressive payment shall be made in respect of the following:

a) Design engineering  
b) Civil construction including foundation and buildings  
c) Structural fabrication and erection  
d) Supply of equipment  
e) Machinery Erection  
f) Trial Run and commissioning  
g) Final Bill after successful performance test etc.

All such payments shall be made by the Employer through Account Payee Cheque within a month from the date of the submission of claims/bills. Payment will also be governed by Clauses 31.1.1, 31.1.3 and 31.7 of Instructions to Bidders. Any sum due from the Contractor shall be deducted from the first or next subsequent on account of payments as the case may be, in general the following procedure of payment shall be followed:

41.7.4.1 Design and Engineering.

a) 80% payment on completion of approval of system, mechanical, electrical, civil, structural design, drawings etc. as per contract on pro-rata basis.  
b) 10% payment on Preliminary acceptance of the works after start-up and trial operation as per clause 14.1/14.2 of General Technical Conditions (GTC).  
c) 10% on issue of final acceptance certificate of the works after performance and guarantee test as per clause 14.3 of GTC.

41.7.4.2 Supply of Equipment:

a) 80% payment on receipt of the equipment conforming to stipulated specifications and quality in good condition at site to be certified by the site engineer.  
b) 10% on preliminary acceptance of the works after start-up and trial operation as per clause 14.1/14.2 of GTC  
c) 10% on issue of final acceptance certificate of the works after performance and guarantee test as per clause 14.3 of GTC

41.7.4.3 Civil/Structural Works:

a) 80% payment on progress of work completed, duly measured and certified by the engineer.  
b) 10% payment on preliminary acceptance of the works after start-up and trial operation as per clause 14.1/14.2 of GTC  
c) 10% on issue of final acceptance certificate of the works after performance and guarantee test as per clause 14.3 of GTC

41.7.4.4 Installation & Commissioning:

a) 80% progress payment based on the installation and commissioning of plant and equipment duly certified by site engineer.  
b) 10% payment on preliminary acceptance of the works after start-up and trial operation as per clause 14.1/14.2 of GTC  
c) 10% on issue of final acceptance certificate of the works after performance and guarantee test as per clause 14.3 of GTC
41.7.4.5 Final Bill:

As soon as possible after completion of the works to the satisfaction of the Employer the Contractor shall forward a certified final bill. It shall be accompanied by all relevant vouchers, such as royalty clearance certificate (if any) from appropriate authorities, submission of copies of working drawings, technical documents as required documents showing therein all additions and alternations etc. in the process of execution, completion certificate for embedded and covered up works, plant handing over certificate etc. as applicable. The Contractor shall be paid full and final payment only after deduction of amounts paid against on account bill and any other amount due etc. payable by Contractor.

42.0 SETTLEMENT OF DISPUTES

It is incumbent upon the contractor to avoid litigation and disputes during the course of execution. However, if such disputes take place between the contractor and the department, effort shall be made first to settle the disputes at the company level.

The contractor should make request in writing to the Engineer-in-charge for settlement of such disputes/ claims within 30 (thirty) days of arising of the cause of dispute/ claim failing which no disputes/ claims of the contractor shall be entertained by the company.

If differences still persist, the settlement of the dispute with Govt. Agencies shall be dealt with as per the Guidelines issued by the Ministry of Finance, Govt. of India in this regard. In case of parties other than Govt. Agencies, the redressal of the dispute may be sought in the Court of Law.

43.0 TAXES

All taxes, levies, cess, royalties, whether local, municipal, provincial or central pertaining to the contract are payable during the entire periods of contract, shall be to the contractor/ contractors account and shall be deemed to have been included in the contracted rate for the work to be executed by the contractor. The Company shall not be liable for any taxes or levies etc. whatsoever in connection with this contract.

The Company reserves the right to deduct/ withhold any amount towards taxes/ Statutory levies, as may be required under the Statute or in terms of direction from any Authority from the amount as directed by the appropriate Authority and the Company shall only provide with certificate towards deduction and shall not be responsible for any reason whatsoever.

This clause is to be read with clause 2.6 of ADDITIONAL TERMS AND CONDITIONS.

Necessary " C " form will be issued as applicable.

SERVICE TAX- service tax if any applicable to this contract will be reimbursed by the company at actual on production of documentary proof.
SUB-SECTION -4.2

ADDITIONAL TERMS AND CONDITIONS OF CONTRACT
SUB-SECTION – 4.2

ADDITIONAL TERMS & CONDITIONS OF CONTRACT

The following additional terms & conditions are also acceptable to the company. The tenderers are requested not to quote any additional conditions in their tender.

1. MOBILISATION ADVANCE :

i) In the case of works whose estimated value is more than Rs.100.00 lakhs, a maximum of 10% of the total contract value of work will be paid as mobilisation advance subject to submission of Bank Guarantee for equal amount.

ii) Mobilisation Advance against survey, soil investigation, design and engineering will be paid in two equal instalments - one after signing of the agreement and the second after the system design drawings have been completed and detailed design work is to be taken up by the contractor.

iii) Mobilisation Advance against supply of equipments shall be released only after the contractor has finalised their vendors/suppliers for the specific equipment and the amount of advance shall be proportionate to the value of equipment for which vendors/suppliers have been finalised vis-à-vis the total value of equipments offered in the contract limited to 10% of the contract value.

iv) Mobilisation Advance against works contract for site activities shall be paid in two equal instalments. First installment shall be paid after the contractor has opened their site office and having finalised their subcontractors. The second installment shall be paid for taking procurement action of construction materials like reinforcing steel and structural steel by the contractor.

v) The mobilisation advance shall be recovered from the bills of the contractor from the second running on account bills onward @ 20% of the advance amount paid.

vi) The value of Bank Guarantee may be reduced to the extent such advance is recovered by the company subject to the conditions that the value of Bank Guarantee amount at any time is more than the recoverable outstanding advance. Bank Guarantee shall be irrevocable and from a Nationalised Bank/Scheduled Bank.

vii) Interest on mobilisation advance will be charged as per the rate of CIL’s borrowing rate under cash credit arrangement as varying from time to time.

2.0 PRICE VARIATION CLAUSE :

2.1 The contract price shall remain firm without any price variation due to escalation for the portions of survey, geo-engineering investigations, design and engineering and supply of equipments, plant and machineries as envisaged in the scope of work and the price agreed thereon as per the contract except the statutory increase/decrease in taxes and duties such as excise duty, sales tax, import duty etc.

2.1.1 If the contract is to be extended beyond the stipulated period for completion of the work due to fault on the part of the contractor escalation on prices shall not be allowed further if not provided otherwise in the accepted contract.

2.2 For the portions of civil and structural works and erection and commissioning works of the plant & machineries, the price variation due to escalation shall be allowed to the extent as detailed hereinafter
2.2.1 If the prices of materials (not being materials supplied at fixed issue rates by the company) and wages of labour, required for execution of the work, increase, the contractor shall be compensated for such increase as per provisions detailed below:

a) The amount of the contract shall accordingly be varied, subject to the condition that such compensation for variation in prices shall be available only for the work done during the stipulated period of the contract as per the work programme agreed including such period for which the contract is validly extended under the provisions of the contract without any penal action.

b) The base date for working out such price variation shall be thirty (30) days prior to the date set for opening of the bids or the revised price bid whichever is later.

c) The compensation of Price variation shall be worked out at quarterly intervals and shall be with respect to the cost of work done during the previous three months. The first such payment shall be made at the end of three months after the month (Excluding) in which the tender was accepted and thereafter at three months' interval.

2.2.1.1 PRICE VARIATION FOR LABOUR:

The amount paid to the contractor for the work done shall be adjusted for increase or decrease in the cost of labour and the cost shall be calculated quarterly in accordance with the following formula:

\[ V_L = \frac{A}{100} \times \frac{L - L_0}{L_0} \times W \]

Where:

\( V_L \) = Variation in labour cost i.e. increase or decrease in the amount in rupees to be paid or recovered.

\( W \) = Value of work done during the period under reckoning to which the price variation relates as indicated in clause no. 2.3 of the 'ADDITIONAL TERMS & CONDITIONS OF CONTRACT'.

\( A \) = Component of labour expressed as percentage of the total value of work adopted from Table-1

\( L_0 \) = Minimum wages for unskilled workers payable as per the Minimum Wages Act / Rules of the State or Central Government, whichever is more, applicable to the place of work as on the last date stipulated for receipt of the Price bids or Revised Price bids whichever is later.

\( L \) = Revised minimum wages of unskilled workers corresponding to \( L_0 \) during the period to which the escalation relates.

2.2.1.2 Price Variation on Materials:

The amount to be paid to the contractor for the work done shall be adjusted for increase or decrease in the cost of materials and the cost shall be calculated quarterly in accordance with the following formula:

\[ V_m = \frac{B}{100} \times \frac{M - M_0}{M_0} \times W \]

Where:

\( V_m \) = Variation in material cost i.e. increase or decrease in the amount in rupees to be paid or recovered.

\( W \) = Value of work done during the period under reckoning to which the price variation relates as indicated in clause no. 2.3 of the 'ADDITIONAL TERMS & CONDITIONS OF CONTRACT'.

\( B \) = Component of material expressed as percentage of the total value of work adopted from Table-1

\( M_0 \) = Minimum rates of materials as on the last date stipulated for receipt of the Price bids or Revised Price bids whichever is later.

\( M \) = Revised minimum rates of materials corresponding to \( M_0 \) during the period to which the escalation relates.
Where:

\( V_m \) = Variation in material cost i.e. increase or decrease in the amount in rupees to be paid or recovered.

\( W \) = Value of work done during the period under reckoning to which the price variation relates as indicated in clause no. 2.3 of the 'ADDITIONAL TERMS & CONDITIONS OF CONTRACT'.

\( B \) = Component of material expressed as percentage of the total value of work adopted from Table-1

\( M \) = Average All India Wholesale Price Index for all commodities for the period to which price variation relates as published by the RBI Bulletin, Ministry of Industry & Commerce, Govt. Of India.

\( M_0 \) = All India Wholesale Price Index for all commodities as published by the RBI Bulletin, Ministry of Industry & Commerce, Govt. Of India, relating to the last date on which the price bids or revised price bids whichever is later were stipulated to be received.

2.2.1.3 PRICE VARIATION ON POL:

The amount to be paid to the contractor for the work done shall be adjusted for increase or decrease in the cost of POL and the cost shall be calculated quarterly in accordance with the following formula:

\[
V_f = W \times \frac{C}{100} \times \frac{F - F_0}{F_0}
\]

Where:

\( V_f \) = Variation in the cost of fuel, oil & lubricants increase or decrease in the amount in rupees to be paid or recovered.

\( W \) = Value of work done during the period under reckoning to which the price variation relates as indicated in clause no. 2.3 of the 'ADDITIONAL TERMS & CONDITIONS OF CONTRACT'.

\( C \) = Component of POL expressed as percentage of the total value of work adopted from Table-1

\( F \) = Average Index Number for Wholesale Price for the group of fuel, power, light and lubricants as published by Economic Advisor, Ministry of Industry, Govt. Of India for the period to which price variation relates.

\( F_0 \) = Index Number for Wholesale Price for the group of "fuel, power, light and lubricants" as published by Economic Advisor, Ministry of Industry, Govt. Of India prevalent on the last date of receipt of price bids whichever is later.

2.3 WHILE CALCULATING THE VALUE OF "W" THE FOLLOWING MAY BE NOTED:

The cost on which the escalation/price variation shall be payable shall be reckoned as 85% of the cost of work as per the bills to which escalation relates, and from this amount the value of materials supplied or services rendered at the prescribed charges under the relevant provisions of the contract, and proposed to recovered in the particular bill, shall be deducted before the amount of compensation for
escalation/price variation is worked out. Further the cost shall not include any work for which payment is made at prevailing market rates.

2.4 In the event the price of materials and/or wages of labour required for execution of the work decreases, there shall be downward adjustment of the work so that such price of materials and/or wages of labour shall be deductible from the cost of work under this contract and in this regard the formulae hereinbefore stated under this clause shall mutatis/mutandis apply.

For all other works not listed above, the component of labour, material and POL of the total cost of work shall be as specifically indicated in the tender document.

The price variation clause as stated above will be applied for extended time frame of a contract by following the principles as under

i) Normally, if and when it is understood that a contract is not going to be completed within the scheduled time period, the contract is kept operative by extending the time of completion provisionally. During this provisional extended period the operation of the Price Variation Clause will remain suspended.

ii) If and when it is decided at the end of the successful completion of the work that the delay was due to causes not attributable to the contractor, then the Price Variation Clause will be revived and applied as if the scheduled date of completion has been shifted to the approved extended date.

iii) If it is decided at the end of successful completion of the work that the delay was due to the fault of the contractor then the Price Variation Clause will not be revived and no payment will be made to the contractor on this account. Additionally the Clause related to Compensation for delay will be applied.

iv) In some cases the total delay may be partially due to causes not attributable to the contractor and partially due to his fault. It may be difficult to exactly quantify the total delay proportionately in such cases. The Price Variation Clause under such condition will be made operative for the entire extended time period by freezing the relevant indices on the date of the scheduled date of completion as originally fixed in the contract/agreement. At the same time the Clause related to the compensation for delay will also be applied.

2.5 CEILING ON PRICE VARIATION DUE TO ESCALATION

There shall be a ceiling on price variation due to escalation covered under clauses mentioned hereinbefore on the whole contract, limited to 10% of the 'contract price' only.

2.6 VARIATION IN THE TAXES, DUTIES, LEVIES ETC.

Other statutory variation due to increase in taxes, duties, levies etc. by Govt. (Central or State or Local) as of thirty (30) days prior to the date of opening of the part-I of the bid or the revised price bid, whichever is later, with the taxes, duties, levies etc. during the manufacture/works/supply, as the case may be, shall be born by the owner. Similarly decrease in taxes, duties, levies etc. shall be returned/deducted to/by the owner.
### Table - 1
Value of A, B & C in the Price variation formula in the 'Additional Terms and Conditions of Contract':

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Particulars</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>For Building works</td>
<td>25</td>
<td>75</td>
<td>NIL</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>For Road works</td>
<td>15</td>
<td>80</td>
<td>05</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>For external sewerage, external water supply and external electrification</td>
<td>10</td>
<td>90</td>
<td>NIL</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>For external water supply, external sanitary and external electrification (Through labour rate contract)</td>
<td>75</td>
<td>25</td>
<td>NIL</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>For steel structural works</td>
<td>15</td>
<td>85</td>
<td>NIL</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>For steel structural works with Department free supply of rolled steel sections (Through labour rate contract)</td>
<td>75</td>
<td>25</td>
<td>NIL</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>For Coal Handling Plant Civil works</td>
<td>25</td>
<td>75</td>
<td>NIL</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>For underground civil works such as Incline Privage, Shaft Sinking etc.</td>
<td>35</td>
<td>65</td>
<td>NIL</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>For Erection and Commissioning of P&amp;M</td>
<td>65</td>
<td>35</td>
<td>NIL</td>
<td></td>
</tr>
</tbody>
</table>
SUB-SECTION -4.3

GENERAL TECHNICAL CONDITIONS
SUB-SECTION – 4.3

GENERAL TECHNICAL CONDITIONS

1.0 GENERAL

This part covers technical conditions pursuant to the contract and will form an integral part of the contract. The following provisions shall supplement all the detailed technical specifications and requirements brought out in the accompanying technical specifications. The contractor's proposal shall be based on the use of equipment and materials complying fully with the requirements, specified herein. It is recognised that the contractor may have standardised on the use of certain components, materials, processes or procedures different that those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to the owner.

2.0 LIMIT OF CONTRACT

Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the technical specifications unless included in the list of exclusions. All similar standard components/parts of similar standard equipment provided, shall be inter-changeable with one another.

3.0 EQUIPMENT PERFORMANCE GUARANTEE

3.1 The performance tests of the equipment under the scope of the contract are detailed in the technical specifications. These guarantee shall supplement the general performance guarantee provisions covered under general terms & conditions of contract in clause entitled "Guarantee".

3.2 Liquidated damages for not meeting performance guarantee during the performance and guarantee tests shall be assessed and recovered from the contractor, as detailed in the technical specifications. Such liquidated damages shall be without any limitation whatsoever and shall be in addition to damages, if any payable under any other clauses of conditions of contract.

4.0 ENGINEERING DATA

4.1 The furnishing of engineering data by the contractor shall be in accordance with the schedule for each set of equipment as specified in the technical specifications. The review of these data by the engineer will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under the specifications, external connections and of the dimensions which might affect plant layout. This review by the engineer may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the engineer shall not be construed by the contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

4.2 All engineering data submitted by the contractor after final process including review and approval by the engineer shall form part of the contract documents and the entire works covered under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the engineer in writing.
5.0 DRAWING

5.1 All drawings submitted by the contractor including those submitted at the time of bid shall be sufficiently detailed to indicate the type, size, arrangement, weight of each component, break-up for packing and shipment, the external-connections, fixing arrangements required, the dimensions required for installation and interconnections with other equipment and materials, clearances and spaces required between various portions of equipment and any other information specifically requested in the specifications.

5.2 Each drawing submitted by the contractor shall be clearly marked with the name of the owner, the unit designation, the specifications title, the specification number and the name of the project. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

5.3 The Contractor shall make his drawings in AutoCAD format and shall supply the drawings in CDs along with hardcopies.

5.3.1 Copies of drawings returned to the contractor will be in the form of a print with the owner's marking or print made from CDs for computer based drawings.

5.4 The drawings submitted by the contractor shall be reviewed by the engineer as far as practicable within four (4) weeks and shall be modified by the contractor if any modifications and/or corrections are required by the engineer. The contractor shall incorporate such modifications and/or corrections and submit the final drawings for approval. Any delay arising out of failure by the contractor to rectify the drawings in good time shall not alter the contract completion date.

5.5 Approval by the Nodal Officer or his Nominee the contractor shall submit specifications and drawings showing the proposed Temporary Works to the Nodal Officer/Engineer-In-Charge or his nominee, who is to approve them if they comply with the specification and drawings. The contractor shall be responsible for design of Temporary Works.

The Nodal Officer/Engineer-In-Charge or nominee's approval shall not alter the contractor's responsibility for design of the Temporary Works.

5.6 The drawings sent for approval to the engineer shall be in quintuplicate. One print of such drawings will be returned to the contractor by the engineer marked approved/approved with corrections. The contractor shall thereupon furnish the owner with nine prints and one reproducible original of the drawings after incorporating all corrections.

5.7 Further work by the contractor shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the engineer, if so required.

5.8 All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the contractor's risk. The contractor may make any changes in the design which are necessary to make the equipment conform, to the provisions and intent of the contract and such changes will again be subject to approval by the engineer. Approval of contractor's drawings or work by the engineer shall not relieve the contractor of any of his responsibilities and liabilities under the contract.

5.9 Drawings shall include all installation and detailed piping drawings wherever applicable. All piping 100 mm and larger shall be routed in detail and smaller pipe
shall be shown schematically or by isometric drawings. All drawings shall be fully corrected to agree with actual as built construction.

5.10 Operating and Maintenance Manual: If "as built" drawings and/or operating and maintenance manuals are required the contracts shall supply them by the dates stated in the contract data.

If the contractor does not supply the drawings and/or manuals by the dates stated in the contract data, or they do not receive the Nodal Officer or his nominee's approval, the Nodal Officer or his nominee shall withhold the amount stated in the contract data from payments due to the contractor.

6.0 INSTRUCTION MANUALS

6.1 The contractor shall submit to the engineer, preliminary instruction manuals for all the equipment, covered under the contract within the time agreed upon between the owner & the contractor. The final instruction manuals complete in all respects shall be submitted by the contractor thirty (30) days before the first shipment of the equipment. The instruction manuals shall contain full details and drawings of all the equipment furnished, the erection procedures, testing procedures, operation and maintenance procedures of the equipment. These instruction manuals shall be submitted in the form of one (1) reproducible original and twelve (12) copies.

6.2 If after the commissioning and initial operation of the plant, the instruction manuals require any modifications/additions/changes, the same shall be incorporated and the updated final instruction manuals in the form of one (1) reproducible original and twelve (12) copies shall be submitted by the contractor to the owner.

6.3 The contractor shall furnish to the owner, twelve (12) sets of spare parts catalogue.

6.4 In addition, the contractor shall supply two sets of all the documents, specifications and as built drawings in CDs to CMPDI. The documents supplied shall be in easily readable, search & printable format.

7.0 FIRST FILL OF CONSUMABLE, OILS AND LUBRICANTS

All the first fill of consumable such as oils, lubricants and essential chemicals etc., which will be required to put the equipment covered under the scope of the specifications, into successful trial operation, shall be furnished by the contractor unless specifically excluded under the exclusions in the specifications and other documents.

8.0 MANUFACTURING SCHEDULE

The contractor shall submit to the engineer his manufacture and delivery schedules for all equipment within thirty (30) days from the date of the letter of acceptance of tender. Such schedules shall be in line with the detailed net-work for all phases of the work of the contractor. Such schedules shall be reviewed, up-dated and submitted to the engineer, once every two (2) months thereafter, by the contractor. Schedule shall also include the materials and equipment purchased from outside suppliers.

9.0 REFERENCE STANDARDS

9.1 The codes and/or standards referred to in these specifications shall govern, in all cases wherever such references are made. In case of a conflict between such codes and/or standards and the specifications, the latter shall govern. Such codes and/or standards referred to shall mean the latest revisions, amendments/changes adopted.
and published by the relevant agencies. In case of any further conflict in this matter, the same shall be referred to the engineer whose decision shall be final and binding.

9.2 Other internationally acceptable standards which ensure equal or higher performance than those specified shall also be accepted.

10.0 DESIGN IMPROVEMENT

10.1 The engineer or the contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly.

10.2 If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of completion before the contractor proceeds with the change. Following such agreement the provision thereof, shall be deemed to have been amended accordingly.

11.0 QUALITY ASSURANCE

11.1 Quality Assurance Programme

To ensure that the equipment and services under the scope of this contract whether manufactured or performed within the contractor's works or at his sub-contractor's premises or at the owner's site or at any other place of work are in accordance with the specifications, the contractor shall adopt suitable quality assurance programme to control such activities at all points necessary. Such programme shall be outlined by the contractor and shall be finally accepted by the engineer after discussions before the issue of letter of acceptance of tender. A quality assurance programme of the contractor shall generally cover the following:

a. his organisation structure for the management and implementation of the proposed quality assurance programme;
b. documentation control system;
c. qualification data for bidder's key personnel;
d. the procedure for purchase of materials, parts components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.;
e. system for shop manufacturing and site erection control including process control and fabrication and assembly controls;
f. control of non-conforming items and system for corrective actions;
g. inspection and test procedure both for manufacture and field activities;
h. control of calibration and testing of measuring and testing equipment;
i. system for indication and appraisal of inspection status;
j. system for quality audits;
k. system for authorising release of manufactured product to the owner;
l. system for maintenance of records;
m. system for handling storage and delivery; and
n. a quality plan detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment furnished and each work at different stages executed at work site.

11.2 Quality Assurance Documents

The contractor shall be required to submit the following Quality Assurance Documents within three weeks after despatch of the equipment:

i. all non-destructive examination procedures stress relief and weld repair procedure actually used during fabrication.
ii. welder and welding operator qualification certificates.

iii. welder identification list, listing welder's and welding operator's qualification procedure and welding identification symbols.

iv. material mill test reports on components as specified by the specification.

v. the inspection plan with verification, inspection plan check points, verification sketches, if used, and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.

vi. sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.

vii. all non-destructive examination result reports including radiography interpretation reports.

viii. stress relief time temperature charts.

ix. factory test results for testing required as per applicable codes and standard referred in the specifications.

x. the engineer or his duly authorised representative reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the contractor/his vendor's quality management and control activities.

12.0 ENGINEER'S SUPERVISION

12.1 To eliminate delays and avoid disputes and litigation it is agreed between the parties to the contract that all matters and questions shall be referred to the engineer and his decision shall be final.

12.2 The work shall be performed under the direction and supervision of the engineer. The scope of the duties of the engineer, pursuant to the contract, will include but not be limited to the following:

a. interpretation of all the terms and conditions of these documents and specification.

b. review and interpretation of all the contractor's drawings, engineering data etc.

c. witness or authorise his representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract.

d. inspect, accept or reject any equipment, material and work under the contract.

e. issue certificate of acceptance and/or progressive payment and final payment certificates.

f. review and suggest modifications and improvements in completion schedules from time to time.

g. supervise the quality assurance programme implementation at all stages of the works.

h. to receive and endorse the despatch documents enabling the contractor to clear the consignments.

13.0 INSPECTION, TESTING AND INSPECTION CERTIFICATE

13.1 The engineer, his duly authorised representative and/or outside inspection agency acting on behalf of the owner shall have at all reasonable times access to the contractor's premises or works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled at other premises or works, the contractor shall obtain for the engineer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the contractor's own premises or works.
13.2 The contractor shall give the Engineer/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the contractor's account except for the expenses of the Inspector. The Engineer/Inspector, unless witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is notified as being ready for test/inspection, failing which the contractor may proceed with the test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified copies of tests in triplicate.

13.3 The Engineer or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the contractor, of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the contract. The contractor shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the Engineer/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.

13.4 When the factory tests have been completed at the contractor's or sub-contractor's works, the Engineer/Inspector shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Engineer/Inspector, the certificate shall be issued within fifteen (15) days of the receipt of the contractor's test certificate by the Engineer/Inspector. Failure of the Engineer/Inspector to issue such a certificate shall not prevent the contractor from proceeding with the works. The completion of these tests or the issue of the certificate shall not bind the owner to accept the equipment should it, on further tests after erection, be found not to comply with the contract.

13.5 In all cases where the contract provides for tests whether at the premises or works of the contractor or of any sub-contractor, the contractor, except where otherwise specified, shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Engineer/Inspector or his authorised representative to carry out effectively such tests of the equipment in accordance with the contract and shall given facilities to the Engineer/Inspector or to his authorised representative to accomplish testing.

13.6 The inspection by Engineer and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the contractor is respect of the agreed quality assurance programme forming a part of the contract.

14.0 TEST

14.1 Start up

14.1.1 On completion of erection of the equipment and before start-up, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Engineer and the contractor for correctness and completeness of installation and acceptability of start-up, leading to initial pre-commissioning tests at site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the contractor's quality assurance programme.

14.1.2 The contractor's commissioning/start-up engineers specifically identified as far as possible shall be responsible for carrying out all the pre-commissioning tests. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the complete equipment shall be placed on initial operation during which period the complete equipment shall be operated integral with sub-systems and supporting equipment as a complete plant referred hereinafter as plant.
14.2 Trial Operation

14.2.1 The plant shall then be on trial operation during which period all necessary adjustments shall be made while operating over the full load-range enabling the plant to be made ready for performance and guarantee tests.

14.2.2 The duration of trial operation of the complete equipment shall be fourteen (14) days out of which at least seventy two (72) hours shall be continuous operation on full load or any other duration as may be agreed to, between the engineer and the contractor. The trial operation shall be considered successful, provided that each item of the equipment can operate continuously at the specified operating characteristics, for the period of trial operation.

14.2.3 For the period of trial operation, the time of operation with any load shall be counted. Minor interruptions not exceeding four (4) hours at a time, caused during the continuous operation shall not affect the total duration of trial operation. However, if in the opinion of the engineer, the interruption is long, the trial operation shall be prolonged for the period of interruption.

14.2.4 A trial operation report comprising of observations and recordings of various parameters to be measured in respect of the above trial operation shall be prepared by the contractor. This report, besides recording the details of the various observations during trial run, shall also include the dates of start and finish of the trial operations and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the trial operation. Based on the observations, necessary modifications/ repairs to the plant shall be carried out by the contractor to the full satisfaction of the engineer to enable the later to accord permission to carry out performance and guarantee tests on the plant. However, minor defects which do not endanger the safe operation of the equipment, shall not be considered as reasons for with holding the aforesaid permission.

14.3 Performance and guarantee test

14.3.1 The final test as to the performance and guarantees shall be conducted at site, by the owner. Such tests will be commenced within a period of two (2) months after successful completion of trial operations. Any extension of time beyond the above two (2) months shall be mutually agreed upon.

14.3.2 These tests shall be binding on both the parties of the contract to determine compliance of the equipment with the performance guarantees.

14.3.3 The available instrumentation and control equipment will be used during such tests and the engineer will calibrate, all such measuring equipment and devices as far as practicable. However, unmeasurable parameters shall be taken into account in a reasonable manner by the engineer, for the equipment of these tests. The tests will be conducted at the specified load points and as near the specified cycle condition as practicable. The engineer will apply proper corrections in calculation, to take into account conditions which do not correspond to the specified conditions.

14.3.4 Any special equipment, tools and tackles required for the successful completion of the performance and guarantee tests shall be provided by the contractor, free of cost.

14.3.5 The guaranteed performance figures of the equipment shall be proved by the contractor during these performance and guarantee tests. Should the results of these tests show any decrease from the guaranteed values, the contractor shall modify the equipment as required to enable it to meet the guarantees. In such case,
performance and guarantee tests shall be repeated within one month, from the date the equipment is ready for re-tests and all cost for modifications including labour, materials and the cost of additional testing to prove that the equipment meets the guarantees, shall be borne by the contractor. Duration of performance guarantee tests will be of one month of which 6 (six) days continuous on load operation is the minimum requirement and in case it fails, the process of performance guarantee tests will be repeated.

14.3.6 The specific tests to be conducted on equipment has been brought out in the technical specifications.

14.3.7 Performance and guarantee test shall make allowance for instrumentation errors as may be decided by the engineer-in-charge.

14.4 TEST CODES

The provisions outlined in the ASME performance test codes or other international and Indian approved equivalents shall generally be used as a guide for all the above test procedures unless otherwise specified in the technical specifications.

15.0 PACKING

15.1 All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials, the limitation from the point of view of availability of railway wagon sizes in India should be taken into account. The contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing.

16.0 PROTECTION

All coated surfaces shall be protected against abrasions, impact, discoloration and any other damages. All exposed threaded portions shall be suitable protected with either a metallic or a non-metallic protecting device. All ends of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner.

17.0 PRESERVATIVE SHOP COATING

17.1 All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall before hand be treated and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scale, oxide and other coatings and prepared in the shop. The surfaces that are to be finish painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Transformers and other electrical equipment, if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colours shall be as per manufacturer's standards, to be selected and specified by the engineering at a later date.

17.2 Shop primer for all steel surface which will be exposed to operating temperature below 95°C shall be selected by the contractor, after obtaining specific approval of the engineer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperatures higher than 95°C and such primers shall also be subject to the approval of the engineer.
17.3 All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the engineer.

18.0 PROTECTIVE GUARDS

Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purposes.

19.0 DESIGN CO-ORDINATION

The contractor shall be responsible for the selection and design of appropriate equipment to provide the best co-ordinated performance of the entire system. The basic design requirements are detailed out in Technical Specifications. The design of various components, sub-assemblies and assemblies shall be so done, so that it facilitates easy field assembly and maintenance. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical at or close to the operating range of the unit.

20.0 DESIGN CO-ORDINATION MEETING

The contractor will be called upon to attend design co-ordination meetings with the engineer, other contractors and the consultants of the owner during the period of contract. The contractor shall attend such meetings at his own cost at the office of the General Manager(E&M), CMPDI, Ranchi or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during those discussions.

21.0 TOOLS AND TACKLES

The contractor shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipment. However, these tools and tackles shall be separately packed and brought on to site.

22.0 NOISE LEVEL

The equivalent 'A' weighted sound level measured at a distance of 1.5 metres above floor level in elevation and one metre horizontally from the base of any equipment furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA.

23.0 TAKING OVER

Upon successful completion of all the tests to be performed at site on equipment furnished and erected by the contractor, the engineer shall issue to the contractor a taking over certificate as a proof of the final acceptance of the equipment. Such certificate shall not unreasonably be with held nor will be engineer delay the issuance thereof, on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the contractor of any of his obligations which otherwise survive, by the terms and conditions of the contract after issuance of such certificate.

24.0 INDIAN STANDARDS

Normally Indian Standards as published by BUREAU OF INDIAN STANDARDS shall be followed. Wherever relevant Indian Standard is not published by the BIS,
International Standards or American Standard or German Standard or British Standard, as decided by the Engineer in consultations with the Consultants employed by the Owner, shall be followed.

25.0 WELDING

If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipment to be procured by the owner under separate specifications, the requirements shall be submitted to the engineer in advance of commencement of erection work.

26.0 LUBRICATION

Equipment shall be lubricated by systems designed for continuous operation. Lubricant level indicators shall be furnished and marked to indicate proper levels under both stand-still and operating conditions.

27.0 EQUIPMENT BASES

A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete/structural steel base unless otherwise agreed to by the engineer. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.

28.0 RATING PLATES, NAME PLATES AND LABELS

28.1 Each main and auxiliary items of plant is to have permanently attached to it in a conspicuous position a rating plate of non corrosive material upon which is to be engraved the manufacturer's name, equipment, type or serial number, together with details of the loading conditions under which the item of plant in question have been designed to operate, and such diagram plates as may be required by the engineer.

28.2 Each item of plant is to be provided with a nameplate or label designating the service of the particular equipment. The inscriptions are to be approved by the engineer or shall be as detailed in the appropriate sections of the technical specifications.

28.3 Such nameplates or labels are to be of white non-hygrosopic material with engraved black lettering or, alternatively, in the case of indoor circuit breakers, starters etc. of transparent plastic material with suitably coloured lettering engraved on the back.

28.4 Items of plant such as valves, which are subject to handling, are to be provided with an engraved chromium plated nameplate or label with engraving filled with enamel.

28.5 All such name plates, instruction plates, lubrication charts etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided.

29.0 COLOUR CODE FOR PIPE SERVICES

All pipe services wherever applicable are to be painted in accordance with the owner's standard colour scheme, by the contractor.
30.0 SERVICE BY THE OWNER

30.1 The following services shall be provided by the owner:

i. Construction/ drinking water at one point within 100 metres of the work site, charges to be decided by the company.

ii. Auxiliary power for construction at one point within 100 metres of the worksite, charges to be decided by the company.

30.2 In the event of the contractor requiring these services at parameters other than those specified above, for any systems, equipment, instrument etc. he shall make the necessary arrangements himself.
SUB-SECTION – 4.4

ERECTION CONDITIONS OF CONTRACT
SUB-SECTION – 4.4 ERECTION

CONDITIONS OF CONTRACT

1.0 GENERAL

1.1 The following shall supplement the conditions already contained in the other parts of these specifications and documents and shall govern that portion of the work of this contract to be performed at site.

1.2 The contractor upon signing of the contract shall, in addition to a project coordinator, nominate another responsible officer as his representative at site suitably designated for the purpose of overall responsibility and co-ordination of the works to be performed at site. Such person shall function from the site office of the contractor during the pendency of contract.

2.0 REGULATION OF LOCAL AUTHORITIES AND STATUTES

2.1 The contractor shall comply with all the rules and regulations of local authorities during the performance of his field activities. He shall also comply with the minimum wages act, 1948 and the payment of wages act (both of the Government of India and the local State Government) and the rules made there under in respect of any employee or workman employed or engaged by him or his subcontractor. The contractor shall make all necessary payments of the Provident Fund for the workmen employed by him for the work as per the laws prevailing under provisions of CMPF and Allied Schemes and CMPF and Miscellaneous Provisions Act 1948.

2.2 All registration and statutory inspection fees, if any, in respect of his work pursuant to this contract shall be to the account of the contractor. However, any registration, statutory inspection fees lawfully payable under the provisions of the rules and regulations of the Government and any other statutory laws and its amendments from time to time during erection in respect of the plant equipment ultimately to be owned by the owner, shall be to the account of the owner. Should any such inspection or registration need to be arranged due to the fault of the contractor or his sub-contractor, the additional fees for such inspection and/or registration shall be borne by the contractor.

3.0 OWNER'S LIEN ON EQUIPMENT

The owner shall have lien on all equipment including those of the contractor brought to the site for the purpose of erection, testing and commissioning of the plant. The owner shall continue to hold the lien on all such equipment throughout the period of contract. No material brought to the site shall be removed from the site by the contractor and/or his subcontractors without the prior written approval of the engineer.

4.0 INSPECTION, TESTING AND INSPECTION CERTIFICATES

The provisions of the clause entitled inspection testing and inspection certificates under section GTC shall also be applicable to the erection portion of the works. The engineer shall have the right to re-inspect any equipment though previously inspected and approved by him, at the contractor's works, before and after the same are constructed and/or erected at site. If by the above inspection, the engineer rejects any work or equipment, the contractor shall make good for such rejection either by replacement or modifications/repairs as may be necessary, to the satisfaction of the engineer. Such replacement will also include the replacement or re-execution of such of those works of other contractors and/or
agencies, which might have got damaged or affected by the replacements or rework done to the contractor's work.

5.0 ACCESS TO SITE AND WORKS ON SITE

5.1 Suitable access to and possession of the site shall be accorded to the contractor by the owner in reasonable time.

5.2 The owner shall have the necessary foundations to be provided by him ready, as per the agreed schedule for the execution of the individual phases of works.

5.3 The works so far as it is carried out on the owner's premises, shall be carried out at such time as the owner may approve and the owner shall give the contractor reasonable facilities for carrying out the works.

5.4 In the execution of the works, no persons other than the contractor or his duly appointed representative, sub-contractor and workmen, shall be allowed to do work on the site, except by the special permission, in writing of the engineer or his representative.

6.0 CONTRACTOR'S SITE OFFICE ESTABLISHMENT

The contractor shall establish a site office at the site and keep posted an authorised representative for the purpose of the contract. Any written order or instruction of the engineer or his duly authorised representative, shall be communicated to the said authorised resident representing the contractor and the same shall be deemed to have been communicated to the contractor at his legal address.

7.0 CO-OPERATION WITH OTHER CONTRACTORS

7.1 The contractor shall co-operate with all other contractors or tradesmen of the owner, who may be performing other works on behalf of the owner and the workmen who may be employed by the owner and doing work in the vicinity of the works under the contract. The contractor shall also so arrange to perform his work as to minimise, to the maximum extent possible, interference with the work of other contractors and his workmen. Any injury or damage that may be sustained in the employees of the other contractors and the owner, due to the contractor's work shall promptly be made good at his own expense. The engineer shall determine the resolution of any difference or conflict that may arise between the contractor and other contractors or between the contractor and the workmen of the owner in regard to their work. If the works of the contractor is delayed because of any acts or omissions of another contractor, the contractor shall have no claim against the owner on that account other than an extension of time for completing his works.

7.2 The engineer shall be notified promptly by the contractor of any defects in the other contractor's works that could affect the contractor's works. The engineer shall determine the corrective measures if any, required to rectify this situation after inspection of the works and such decisions by the engineer shall be binding on the contractor.

8.0 DISCIPLINE OF WORKMEN

The contractor shall adhere to the disciplinary procedure set by the engineer in respect of his employees and workmen at site. The engineer shall be at liberty to object to the presence of any representative or employees of the contractor at the site, if in the opinion of the engineer such employee has mis-conducted himself or be incompetent or negligent or otherwise undesirable and then the contractor shall
remove such a person objected to and provide in his place a competent replacement.

9.0 CONTRACTOR'S FIELD OPERATION

9.1 The contractor shall keep the engineer informed in advance regarding his field activity plans and schedules for carrying out each part of the works. Any review of such plan or schedule or method of work by the engineer shall not relieve the contractor of any of his responsibilities towards the field activities. Such reviews shall also not be considered as an assumption of any risk or liability by the engineer or the owner or any of his representatives and no claim of the contractor will be entertained because of the failure or inefficiency of any such plan or schedule or method of work reviewed. The contractor shall be solely responsible for the safety, adequacy and efficiency of plant and equipment and his erection methods.

9.2 The contractor shall have complete responsibility for the conditions of the work site including the safety of all persons employed by him or his sub-contractor and all the properties under his custody during the performance of the work. This requirement shall apply continuously till the completion of the contractor and shall not be limited to normal working hours. The construction review by the engineer is not intended to include review of contractor's safety measures in, on or near the work-site, and their adequacy or otherwise.

10.0 PHOTOGRAPIHS AND PROGRESS REPORT

10.1 The contractor shall furnish three (3) prints each to the engineer of progress photographs of the work done at site. Photographs shall be taken as and when indicated by the engineer or his representative. Photographs shall be adequate in size and number to indicate various stages of erection. Each photograph shall contain the date, the name of the contractor and the title of the photograph.

10.2 The above photographs shall accompany the monthly progress report detailing out the progress achieved on all erection activities as compared to the schedules. The report shall also indicate the reasons for the variance between the scheduled and actual progress and the action proposed for corrective measures wherever necessary.

11.0 MAN-POWER REPORT

11.1 The contractor shall submit to the engineer, on the first day of every month, a man hour schedule for the month, detailing the man hours scheduled for the month, skill wise and area-wise.

11.2 The contractor shall also submit to the engineer on the first day of every month, a man power report of the previous months detailing the number of persons scheduled to have been employed and actually employed, skill-wise and areas of employment of such labour.

12.0 PROTECTION WORK

The contractor shall have total responsibility for protecting his works till it is finally taken over by the engineer. No claim will be entertained by the owner or the engineer for any damage or loss to the contractor's works and the contractor shall be responsible for the complete restoration of the damaged works to its original condition to comply with the specifications and drawings. Should any such damage to the contractor's works occur because of other party not under his supervision or control, the contractor shall make his claim directly with the party concerned. If dis-
agreement or conflict or dispute develops between the contractor and the other party or parties concerned regarding the responsibility for damage to the contractor's works the same shall be resolved as per the provisions of the clause 7.0 above entitled co-operation with other contractors. The contractor shall not cause any delay in the repair of such damaged works because of any delay in the resolution of such disputes. The contractor shall proceed to repair the work immediately and the cause thereof will be assigned pending resolution of such dispute.

13.0 EMPLOYMENT OF LABOUR

13.1 The contractor will be expected to employ on the work only his regular skilled employees with experience of his particular work. No female labour shall be employed after darkness no persons below the age of eighteen years shall be employed.

13.2 All travelling expenses including provisions of all necessary transport to and from site lodging allowances and other payments to the contractor's employees shall be the sole responsibility of the contractor.

13.3 The hour of work on the site shall be decided by the owner and the contractor shall adhere to it. Working hours will normally be eight (8) hours per day- Monday through Saturday.

13.4 Contractor's employees shall wear identification badges while on work on site.

13.5 In case the owner becomes liable to pay any wages or dues to the labour or to any Government agency under any of the provisions of the Minimum Wages Act, Workmen compensation Act, Contract Labour Regulation Abolition Act, CMPF Act Act or any other law due to act of omission of the contractor, the owner may make such payments and shall recover the same from the contractor's bills.

14.0 FACILITIES TO BE PROVIDED BY THE OWNER

14.1 SPACE :

The contractor shall advise the owner within thirty (30) days from the date of acceptance of the letter of award, about his exact requirement of space for his office, mess-rooms storage area, pre-assembly and fabrication areas, labour colony area, toilets, etc. The above requirement shall be reviewed by the engineer and space will be allotted to the contractor for construction of his temporary structures like office, storage sheds, labour and staff colony and other utilities etc. for his own as well as his sub-contractor's use.

14.2 ELECTRICITY

The contractor shall submit to the engineer within thirty (30) days from the date of acceptance of the award letter, his electrical power requirements, if any, to allow the planning of the temporary electrical distribution by the engineer. The contractor shall be provided with supply of electricity for the purposes of the contract, only at one point in the project site. The contractor shall make his own further distribution arrangement. All temporary wiring must comply with local regulations and will be subject to engineer's inspection and approval before connection to supply. Power supply for labour colonies shall also be provided at one point. The contractor shall be charged for the power supplied at work site and labour colonies at prevalent rate of power supplied by State Electricity Board. The electricity shall be supplied at one point at suitable voltage as available during construction. If any transformation of voltage required to suit the requirement of the contractor, the same may be done by the contractor as per their requirement at their cost.
14.3 **WATER**

Supply of water will be made available for the construction purposes at an agreed single point within 100 metres of the work site. And further distribution will be the responsibility of the contractor. The contractor shall be charged for the water supplied at work site @ 1% of the value of civil works and shall be deducted from the contractor's running/final bills.

15.0 **FACILITIES TO BE PROVIDED BY THE CONTRACTOR**

15.1 **Tools, tackles and scaffoldings**

The contractor shall provide all the construction equipment, tools, tackles and scaffoldings required for pre-assembly, erection, testing and commissioning of the equipment covered under the contract. He shall submit a list of all such materials to the engineer before the commencement of pre-assembly at site. These tools and tackles shall not be removed from the site without the written permission of the engineer.

15.2 **Communication**

The owner will extend the telephone & telex facilities, if available at site, for purposes of contract. The contractor shall be charged at actuals for such facilities.

15.3 **First – aid**

15.3.1 The contractor shall provide necessary first-aid facilities for all his employees, representatives and workmen working at the site. Enough number of contractor's personnel shall be trained in administering first-aid.

15.3.2 The owner will provide the contractor, in case of an emergency, the services of an ambulance for transportation to the nearest hospital.

15.4 **Cleanliness**

15.4.1 The contractor shall be responsible for keeping the entire area allotted to him clean and free from rubbish, debris etc. during the period of contract. The contractor shall employ enough number of special personnel to thoroughly clean his work area at least once in a day. All such rubbish and scrap material shall be stacked or disposed in a place to be identified by the engineer. Materials and stores shall be so arranged to permit easy cleaning of the area in areas where equipment might drip oil and cause damage to the floor surface, a suitable protective cover of a flame resistant, oil proof sheet shall be provided to protect the floor from such damage.

15.4.2 Similarly the labour colony, the offices and the residential areas of the contractor's employees and workmen shall be kept clean and neat to the entire satisfaction of the engineer. Proper sanitary arrangement shall be provided by the contractor, in the work areas, office and residential areas of the contractor.

16.0 **LINES AND GRADES**

All the works shall be performed to the lines, grades and elevations indicated on the drawings. The contractor shall be responsible to locate and layout the works. Basic horizontal and vertical control points will be established and marked by the engineer at site at suitable points. These points shall be used as datum for the works under the contract. The contractor shall inform the engineer well in advance.
of the times and places at which he wishes to do work in the area allotted to him, so that suitable datum points may be established and checked by the engineer to enable the contractor to proceed with his works. Any work done without being properly located may be removed and/or dismantled by the engineer at contractor's expense.

17.0 FIRE PROTECTION

17.1 The work procedures that are to be used during the erection shall be those which minimise fire hazards to the extent practicable. Combustible materials, combustible waste and rubbish shall be collected and removed from the site at least once each day. Fuels, oils and volatile or flammable materials shall be stored away from the construction and equipment and materials storage areas in safe containers. Untreated canvas paper, plastic or other flammable flexible materials shall not at all be used at site for any other purpose unless otherwise specified. If any such materials are received with the equipment at the site, the same shall be removed and replaced with acceptable material before moving into the construction area or storage.

17.2 Similarly corrugated paper fabricated cartons etc. will not be permitted in the construction area either for storage or for handling of materials. All such materials used shall be water proof and flame resistant type. All the other materials such as working drawings, plants, etc. which are combustible but are essential for the works to be executed shall be protected against combustion resulting from welding sparks, cutting flames and other similar fire sources.

17.3 All the contractor's supervisory personnel and sufficient number of workers shall be trained for fire-fighting and shall be assigned specific fire protection duties. Enough of such trained personnel must be available at the site during the entire period of the contract.

17.4 The contractor shall provide enough fire protection equipment of the types and number for the ware-houses, office, temporary structures, labour colony area etc. Access to such fire protection equipment, shall be easy and kept open at all times.

18.0 SECURITY

The contractor shall have total responsibility for all equipment and materials in his custody stored, loose, semi-assembled and/or erected by him at site. The contractor shall make suitable security arrangements including employment of security personnel to ensure the protection of all materials, equipment and works from theft, fire, pilferage and any other damages and loss. All materials of the contractor shall enter and leave the project site only with the written permission of the engineer in the prescribed manner.

19.0 CONTRACTOR'S AREA LIMITS

The engineer will mark-out the boundary limits of access roads, parking spaces, storage and construction areas for the contractor and the contractor shall not trespass the areas not so marked out for him. The contractor shall be responsible to ensure that none of his personnel move out of the areas marked out for his operations. In case of such a need for the contractor's personnel to work out of the areas marked out for him, the same shall be done only with the written permission of the engineer.
20.0 CONTRACTOR’S CO-OPERATION WITH THE OWNER

In cases where the performance of the erection work by the contractor affects the operation of the system facilities of the owner, such erection work of the contractor shall be scheduled to be performed only in the manner stipulated by the engineer and the same shall be acceptable at all times to the contractor. The engineer may impose such restrictions on the facilities provided to the contractor such as electricity, water, etc. as he may think fit in the interest of the owner and the contractor shall strictly adhere etc. such restrictions and cooperate with the engineer. It will be the responsibility of the contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and operation of the equipment systems which are erected by him. The contractor shall also be responsible for flushing and initial filling of all the oil and lubricants required for the equipment furnished and erected by him, so as to make such equipment ready for operation. The contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in these documents and specifications.

21.0 PRE-COMMISSIONING TRIALS AND INITIAL OPERATIONS

The pre-commissioning trails and initial operations of the equipment furnished and erected by the contractor shall be the responsibility of the contractor as detailed in relevant clauses in section GTC. The contractor shall provide, in addition, test instruments, calibrating devices, etc. and the labour required for the successful performance of these trials. It is anticipated that the above test may prolong for a long time, the contractor's workmen required for the above test shall always be present at site during such trials.

22.0 MATERIALS HANDLING AND STORAGE

22.1 All the equipment furnished under the contract and arriving at site shall be promptly received, unloaded and transported and stored in the storage spaces by the contractor.

22.2 Contractor shall be responsible for examining all the shipment and notify the engineer immediately or any damage, shortage, discrepancy, etc. for the purpose of engineer's information only. The contractor shall submit to the engineer every week a report detailing all the receipts during the week. However, the contractor shall be solely responsible for any shortages or damage in transit, handling and/or in storage and erection of the equipment at the site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the contractor.

22.3 The contractor shall maintain an accurate and exhaustive record detailing out the list of all equipment received by him for the purpose of erection and keep such record open for the inspection of the engineer at any time.

22.4 All equipment shall be handled very carefully to prevent any damage or loss. No bare wire ropes, slings, etc. shall be used for unloading and/or handling of the equipment without the specific written permission of the engineer. The equipment stored shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the store shall be moved to the actual location at the appropriate time so as to avoid damage of such equipment at site.

22.5 All electrical panels, control gear, motors and such other devices shall be properly dried by heating before they are installed and energised. Motor bearings, slip rings, commutators and other exposed parts shall be protected against moisture ingress and corrosion during storage and periodically inspected. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion due to prolonged storage.

22.6 All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months from the date of receipt till the date of commissioning and a record of such measured insulation values maintained by the contractor. Such records shall be open for inspection by the engineer.
22.6 The contractor shall ensure that all the packing materials and protection devices used for the various equipment during transit and storage are removed before the equipment are installed.

22.7 The consumable and other supplies likely to deteriorate due to storage must be thoroughly protected and stored in a suitable manner to prevent damage or deterioration in quality by storage.

22.8 All the materials stored in the open or duty location must be covered with suitable weather-proof and flameproof covering materials wherever applicable.

22.9 If the materials belonging to the contractor are stored in areas other than those earmarked for him, the engineer will have the right to get it moved to the area earmarked for the contractor at the contractor's cost.

22.10 The contractor shall be responsible for making suitable indoor storage facilities to store all equipment which require indoor storage. Normally, all the electrical equipment such as motors, control gear, generators, exciters and consumable like electrodes, lubricants etc. shall be stored in the closed storage space. The engineer, in addition, may direct the contractor to move certain other materials which in his opinion will require indoor storage, to indoor storage areas which the contractor shall strictly comply with.

23.0 CONSTRUCTION MANAGEMENT

23.1 The field activities of the contractors working at site, will be co-ordinated by the engineer and the engineer's decision shall be final in resolving any disputes or conflicts between the contractor and other contractors and tradesmen of the owner regarding scheduling and co-ordination of work. Such decision by the engineer shall not be a cause for extra compensation or extension of time for the contractor.

23.2 The engineer shall hold weekly meetings of all the contractors working at site, at a time and a place to be designated by the engineer. The contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the engineer and shall strictly adhere to those decisions in performing his works. In addition to the above weekly meetings, the engineer may call for other meetings either with individual contractors or with selected number of contractors and in such a case the contractor, if called will also attend such meetings.

23.3 Time is the essence of the contract and the contractor shall be responsible for performance this works in accordance with the specified construction schedule. If at any time, the contractor is falling behind the schedule, he shall take necessary action to make good for such delays by increasing his work force or by working overtime or otherwise accelerate the progress of the work to comply with the schedule and shall communicate such actions in writing to the engineer, satisfying that his action will compensate for the delay. The contractor shall not be allowed any extra compensation for such action.

23.4 The engineer shall however not be responsible for provision of additional labour and/or materials or supply or any other services to the contractor except for the coordination work between various contractors as set out earlier.
24.0 FIELD OFFICE RECORDS

The contractor shall maintain at his site office up-to-date copies of all drawings, specifications and other contract documents and any other supplementary data complete with all the latest revisions thereto. The contractor shall also maintain in addition the continuous record of all changes to the above contract documents, drawings, specifications, supplementary data, etc. effected at the field and on completion of his total assignment under the contract shall incorporate all such changes on the drawings and other engineering data to indicate as installed condition of the equipment furnished and erected under the contract. Such drawings and engineering data shall be submitted to the engineer in required number of copies. Daily work programme with progress of the previous day and deployment of labour related to work programme and attendance of workmen deployed during the previous day shall be maintained in a register. This register shall be signed by authorised representative of the contractor which will then be checked and signed by the owner's representative. Every three months this register shall be deposited to the owner which shall then be owners property.

25.0 CONTRACTOR'S MATERIALS BROUGHT ON TO SITE

25.1 The contractor shall bring to site all equipment, parts, materials, including construction equipment, tools and tackles for the purpose of the works with intimation to the engineer. All such goods shall, from the time of their being brought vest in the owner, but may be used for the purpose of the works only and shall not on any account be removed or taken away by the contractor without the written permission of the engineer. The contractor shall nevertheless be solely liable and responsible for any loss or destruction thereof and damage thereto.

25.2 The owner shall have a lien on such goods for any sum or sums which may at any time be due or owing to him by the contractor, under, in respect of or by reasons of the contract. After giving a fifteen (15) days' notice in writing of his intention to do so, the owner shall be at liberty to sell and dispose of any such goods, in such manner as he shall think fit including public auction or private treaty and to apply the proceeds in or towards the satisfaction of such sum or sums due as aforesaid.

25.3 After the completion of the works, the contractor shall remove from the site under the direction of the engineer the materials such as construction equipment, erection tools and tackles, scaffolding etc. with the written permission of the engineer. If the contractor fails to remove such materials, within fifteen (15) days of issue of a notice by the engineer to do so then the engineer shall have the liberty to dispose of such materials as detailed under clause 25.2 above and credit the proceeds thereto the account of the contractor.

26.0 PROTECTION OF PROPERTY AND CONTRACTOR'S LIABILITY

26.1 The contractor shall be responsible for any damage resulting from his operations. He shall also be responsible for protection of all persons including members of public and employees of the owner and the employees of other contractors and sub-contractors and all public and private property including structures, buildings, other plants and equipment and utilities either above or below the ground.

26.2 The contractor will ensure provision of necessary safety equipment such as barriers, signboards, warning lights and alarms, etc. to provide adequate protection to persons and property. The contractor shall be responsible to give reasonable notice to the engineer and the owners of public or private property and utilities when such property and utilities are likely to get damaged or injured during the performance of his works and shall make all necessary arrangements with such owners, related to removal and/or replacement or protection of such property and utilities.
27.0 PAINTING

All exposed metal parts of the equipment including pipings, structure railing etc. wherever applicable, after installation unless otherwise surface protected, shall be first painted with at least one coat of suitable primer which matches the shop primer paint used, after thoroughly cleaning all such parts of all dirt, rust, scales, greases, oils and other foreign materials by wire brushing, scarping or sand blasting, and the same being inspected and approved by the engineer for painting. Afterwards, the above parts shall be finished with two coats of alloyed resin machinery enamel paints. The quality of the finish paint shall be as per the standards of ISI or equivalent and to be of the colour as approved by the engineer.

28.0 INSURANCE

28.1 In addition to the conditions covered under the clause entitled insurance in general terms and conditions of contract of this volume-1, the following provisions will also apply to the portion of the works to be done beyond the contractor's own or his sub-contractor's works.

28.2 Workmen's compensation insurance

This insurance shall protect the contractor against all claims applicable under the Workmen's Compensation Act 1948 (Government of India). This policy shall also cover the contractor against claims for injury, disability disease or death of his or his sub-contractor's employees, which for any reason are not covered under the Workmen's Compensation Act 1948. The liabilities shall not be less than

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28.3 Comprehensive Automobile Insurance

This insurance shall be in such a form to protect the contractor against all claims for injuries, disability, disease and death to members of public including the owner's men and damage to the property of others arising from the use of motor vehicles during on or off the site operations, irrespective of the ownership of such vehicles.

28.4 Comprehensive General Liability Insurance

28.4.1 This insurance shall protect the contractor against all claims arising from injuries, disabilities, disease or death of members of public or damage to property of others, due to any act or omission on the part of the contractor, his agents, his employees, his representatives and sub-contractors or from riots, strikes and civil commotion. The insurance shall also cover all the liabilities of the contractor arising out of the clause entitled defence of suits under General Terms and Conditions of contracts of this volume.1

28.4.2 The hazards to be covered will pertain to all the works which and areas where the contractor, his sub-contractors, his agents and his employees have to perform work pursuant to the contract.

28.5 The above are only illustrative list of insurance covers normally required and it will be the responsibility of the contractor to maintain all necessary insurance coverage to the extent both in time and amount to take care of all his liabilities either direct or indirect, in pursuance of the contract.
29.0 UN-FAVOURABLE WORKING CONDITIONS

The contractor shall confine all his field operations to those works which can be performed without subjecting the equipment and materials to adverse effects, during inclement weather conditions, like monsoon, storms, etc. and during other unfavourable construction conditions. No field activities shall be performed by the contractor under conditions which might adversely affect the quality and efficiency thereof, unless special precautions or measures are taken by the contractor in a proper and satisfactory manner in the performance of such works and with the concurrence of the engineer. Such unfavourable construction conditions will in no way relieve the contractor of his responsibility to perform the works as per the schedule.

30.0 PROTECTION OF MONUMENTS AND REFERENCE POINTS

The contractor shall ensure that any finds such as relic, antiquity, coins, fossils, etc. which he might come across during the course of performance of his works either during excavation or elsewhere, are properly protected and handed over to the engineer. Similarly the contractor shall ensure that the bench marks, reference points, etc., which are marked out either with the help of engineer or by the engineer shall not be disturbed in any way during the performance of his works. If any work is to be performed which disturb such references, the same shall be done only after these are transferred to other suitable locations under the direction of the engineer. The contractor shall provide all necessary materials and assistance for such relocation of reference points etc.

31.0 WORK AND SAFETY REGULATIONS

31.1 The contractor shall ensure proper safety of all the workmen, materials plant and equipment belonging to him or the Company or to others, working at or near the site. The contractor shall also be responsible for provision of all safety notices and safety equipment required both by the relevant legislation and the engineer-in-charge as he may deem necessary.

31.2 The contractor will notify well in advance to the engineer-in-charge of his intention to bring to the site any container filled with liquid or gaseous fuel or explosive or petroleum substance or such chemicals which may involve hazards. The engineer-in-charge shall have the right to prescribe the conditions, under which such container is to be stored, handled and used during the performance of the works and the contractor shall strictly adhere to and comply with such instructions. The engineer-in-charge shall have the right at his sole discretion to inspect any such container or such construction plant/equipment for which material in the container is required to be used and if in his opinion, its use is not safe, he may forbid its' use. No claim due to such prohibition shall be entertained by the owner. Nor the owner shall entertain any claim of the contractor towards additional safety provisions/conditions to be provided for constructed as per engineer-in-charge's instructions.

Further any such decision of engineer-in-charge shall not, in any way, absolve the contractor of his responsibilities, and in case, use of such a container or entry there of into the site area is forbidden by engineer-in-charge, the contractor shall use alternative methods with the approval of engineer-in-charge without any cost implication to Company or extension of work schedule.

31.3 Where it is necessary to provide and/or store petroleum products or petroleum mixtures and explosives, the contractor shall be responsible for carrying out such provision and/or storage in accordance with the rules and regulations laid down in Petroleum Act 1934, Explosives Act 1948, and Petroleum and Carbide of Calcium Manual Published by the Chief Inspector of Explosives of India. All such storage shall have prior approval of the engineer-in-charge. In case, any approvals are necessary from the Chief Inspector (Explosive) or any statutory authorities, the contractor shall be responsible for obtaining the same.
31.4 All equipment used in construction and erection by contractor shall meet Indian, International Standards and where such standards do not exist, the contractor shall ensure these to be absolutely safe. All equipment shall be strictly operated and maintained by the contractor in accordance with manufacturer's operation manual and safety instructions and per Guidelines/Rules of the Company in this regard.

31.5 Periodical Examinations and all tests for all lifting/hoisting equipment and tackles shall be carried out in accordance with the relevant provisions of Factories Act 1948, Indian Electricity Act 1910 and associated Laws/Rules enforced from time to time. A register of such examinations and tests shall be properly maintained by the contractor and will be promptly produced as and when desired by engineer-in-charge or by the person authorised by him.

31.6 The contract shall be fully responsible for the safe storage of his and his subcontractors radioactive sources in accordance with BARC/DAE Rules and other applicable provisions. All precautionary measures stipulated by BARC/DAE in connection with use, storage and handling of such material will be taken by contractor.

31.7 The contractor shall provide suitable safety equipment of prescribed standard to all employee and workmen according to the need, as may be directed by engineer-in-charge who will also have right to examine these safety equipment to determine their suitability, reliability, acceptability and adaptability.

31.8 Where explosives are to be used, the same shall be used under the direct control and supervision of an expert, experienced, qualified and competent person strictly in accordance with the code practices/rules framed under Indian Explosives Act pertaining to handling, storage and use of the explosives.

31.9 The contractor shall provide safe working conditions to all workmen and employees at the site including safe means of access, railings, stairs, ladders, scaffoldings etc. The scaffoldings, stairs, ladders etc. shall be erected under the control and supervision of an experienced and competent person. For erection, good and standard quality of material only shall be used by the contractor.

31.10 The contractor shall not interfere or disturb electric fuses, wiring and other electrical equipment belonging to the owner or other contractors under any circumstances, whatsoever, unless expressly permitted in writing by the Company to handle such fuses, wiring or electrical equipment.

31.11 Before the contractor connects any electrical appliances to any plug or socket belonging to the other contractor or owner, he shall:

   a) satisfy the engineer that the appliances is in good working condition
   b) inform the engineer of the maximum current rating, voltage and phases of the appliances.
   c) obtain permission of the engineer detailing the sockets to which the appliances may be connected.

31.12 The engineer will not grant permission to connect until he is satisfied that:

   a) the appliance is in good condition and is fitted with a suitable plug.
   b) the appliance is fitted with a suitable cable having two earth conductors, one of which shall be an earthed metal sheath surrounding the cores.

31.13 No electric cable is in use by the contractor/owner will be disturbed without prior permission. No weight of any description will be imposed on any cable and no ladder or similar equipment will rest against or attached to it.
31.14 No repair work shall be carried out on any live equipment. The equipment shall must be
declared safe by engineer-in-charge and a permit to work shall be issued by engineer-in-
charge before any repair work is carried out by the contractor. While working on electric
tlines/equipments whether alive or dead, suitable type and sufficient quantity of tools will
have to be provided by contractor to electricians/workmen/officers.

31.15 The contractor shall employ necessary number of qualified, full time electricians/ electrical
supervisors to maintain in his temporary electrical installations.

31.16 The contractor employing more than 250 workmen whether temporary, casual, probationer,
regular or permanent or on contract, shall employ at least one full time officer exclusively as
safety officer to supervise safety aspects of the equipment and workmen who will co-ordinate
with the project safety officer. In case of work being carried out through sub-contractor's, the
sub-contractor's workmen/workmen will also be considered as the contractor's
employees/workmen for above purpose. The name and address of a such safety officer of
contractor will be promptly informed in writing to engineer-in-charge with a copy to safety
officer-in-charge before he starts work or immediately after any change of the incumbent is
made during currency of the contract.

31.17 In case any accident occurs during the construction/erection or other associated activities
undertaken by the contractor thereby causing any minor or major or fatal injury to his
employees due to any reason, whatsoever, it shall be the responsibility of the contractor to
promptly inform the same to the company's engineer-in-charge in prescribed form and also to
all the authorities envisaged under the applicable laws.

31.18 The engineer-in-charge shall have the right at his sole discretion to stop the work, if in his
opinion the work is being carried out in such a way that it may cause accidents and endanger
the safety of the persons and/or property, and/or equipment. In such cases, the contractor
shall be informed in writing about the nature of hazards and possible injury/accident and he
shall comply to remove short comings promptly. The contractor after stopping the specific
work, can, if felt necessary, appeal against the order of stoppage of work to the General
Manager of the project within 3 days of such stoppage of work and decision of the project
G.M in this respect shall be conclusive and binding on the contractor.

31.19 The contractor shall not be entitled for any damages/compensation for stoppage of work due
to safety reasons as provided in para 31.18 above and the period of such stoppage of work
will not be taken as an extension of time for completion of work and will not be the ground
for waiver of levy of liquidated damages.

31.20 The contractor shall follow and comply with all the Company safety rules relevant provisions
of applicable laws pertaining to the safety of workmen, employees, plant and equipment as
may be prescribed from time to time without demur, protest or content or reservation. In case
of any inconformity between statutory requirement and the Company safety rules referred
above, the later shall be binding on the contractor unless the statutory provisions are more
stringent.

31.21 If the contractor fails in providing safe working environment as per the Company safety rules
or continues the work even after being instructed to stop work by engineer-in-charge as
provided in para 31.18 above, the contractor shall promptly pay to the Company, on demand
i.e. by the owner compensation at the rate of Rs. 5,000/= per day or part there of till the
instructions are complied with and so certified by engineer-in-charge. However in case of
accident taking place causing injury to any individual, the provisions contained in para 31.22
shall also apply in addition to compensation mentioned in this para.
31.22 If the contractor does not take all safety precautions and/or fails to comply with the safety rules as prescribed by the Company or under the applicable laws for the safety of the equipment and plant and for the safety of personnel and the contractor does not prevent hazardous conditions which cause injury to his own employees or employees of other contractors, or the Company employees or any other person who are at site or adjacent thereto, the contractor shall be responsible for payment of compensation under the relevant provisions of the workmen's compensation act and rules framed thereunder or any other applicable laws as applicable from time to time.

Permanent disablement shall have same meaning as indicated in workmen's compensation act. The compensation mentioned above shall be in addition to the compensation payable to the workmen/employees under the relevant provisions of the workmen's compensation act and rules framed thereunder or any other applicable laws as applicable from time to time.

In case the owner is made to pay such compensation then the contractor is liable to reimburse the owner such amount.

32.0 CODE REQUIREMENTS

The erection requirements and procedures to be followed during the installation of the equipment shall be in accordance with the relevant Indian standards codes of practices or in their absence appropriate International standards, Indian Boiler Regulations, ASME codes and accepted good engineering practice, the engineer's drawings and other applicable Indian recognised codes and the laws and regulations of the Government of India.

33.0 FOUNDATION DRESSING AND GROUTING

33.1 The surfaces of foundations shall be dressed to bring the top surface of the foundations to the required level, prior to placement of equipment/equipment bases on the foundations.

33.2 All the equipment bases and structural steel base plates shall be grouted and finished as per these specifications unless otherwise recommended by the equipment manufacturer.

33.3 The concrete foundation surfaces shall be properly prepared by chipping, grinding as required to bring the type of such foundation to the required level, to provide the necessary roughness for bondage and to assure enough bearing strength. All laitance and surface film shall be removed and cleaned.
33.4  GROUTING MIX

The grouting mixtures shall be composed of Portland cement, sand and water. The Portland cement to be used shall conform to ISI No. 269 or equivalent, sand shall conform to ISI No.383/2386 or equivalent. The grout proportions for flat based where the grouting space does not exceed 35 mm shall be 50 Kg bag of cement to 75 Kg of sand. Only the required quantity of water shall be added so as to make the mix quaky and flowable and the mix shall not show excess water on top when it is being puddled in place. For thicker grout beds upto 65 mm, the amount of sand shall be increased to 105 Kg per bag of cement. Bases which are hollow and are to be filed full of grouting shall be filled to a level of 25 mm above the outside rim with a mortar mix in the volumetric proportions of one bag of cement and 1.5 bags sand and 1.5 part 6 mm granite gravel. An acceptable plasticiser may be added to the grout mixes in a proportion recommended by the plasticisers manufacturer. All such grouts shall be thoroughly mixed for not less than five minutes in an approved mechanical mixer and shall be used immediately after mixing.

33.5  PLACING OF GROUT

33.5.1  After the base has been prepared, its alignment and level has been checked and approved and before actually placing the grout a low dam shall be set around the base at a distance that will permit pouring and manipulation of the grout. The height of such dam shall be at least 25 mm above the bottom of the base. Suitable size and number of chains shall be introduced under the base before placing the grout, so that such chains can be moved back and forth to push the grout into every part of the space under the base.

33.5.2  The grout shall be poured either through grout holes if provided or shall be poured at one side or at two adjacent sides giving it a pressure head to make the grout move in a solid mass under the base and out in the opposite side. Pouring shall be continued until the entire space below the base is thoroughly filled and the grout stands at least 25 mm higher all around than the bottom of the base. Enough care should be taken to avoid any air or water pockets beneath the bases.
33.6 FINISHING OF THE EDGES OF THE GROUT

The poured grout should be allowed to stand undisturbed until it is well set. Immediately thereafter, the dam shall be removed and grout which extends beyond the edges of the structural or equipment base plates shall be cut off flush and removed. The edges of the grout shall then be pointed and finished with 1:2 cement mortar pressed firmly to bond with the body of the grout and smoothed with a tool to present a smooth vertical surface. The work shall be done in a clean and scientific manner and the adjacent floor spaces, exposed edges of the foundations, and structural steel and equipment base plates shall be thoroughly cleaned of any spillage of the grout.

33.7 CHECKING OF EQUIPMENT AFTER GROUTING

After the grout is set and cured, the contractor shall check and verify the alignment of equipment, alignment of shafts of rotating machinery, the slopes of all bearing pedestals, centring of rotors with respect to their sealing bores, couplings, etc. as applicable and the like items to ensure that no displacement had taken place during grouting. The values recorded prior to grouting shall be used during such post grouting check-up and verifications. Such pre and post grout records of alignment details shall be maintained by the contractor in a manner acceptable to the engineer.

34.0 SHAFT ALIGNMENTS

All the shafts of rotating equipment shall be properly aligned to those of the matching equipment to as perfect an accuracy as practicable. The equipment shall be free from excessive vibration so as to avoid over-heating of bearings or other conditions which may tend to shorten the life of the equipment. All bearings, shafts and other rotating parts shall be thoroughly cleaned and suitably lubricated before starting. All alignment should be checked through alignment cheker or condition monitoring equipment in the presence of the engineer-in-charge.

35.0 DOWELING

All the motors and other equipment shall be suitably doweled after alignment of shafts with tapered machined dowels as per the direction of the engineer.

36.0 CHECK OUT OF CONTROL SYSTEMS / POWER SUPPLY

After completion of wiring, cabling furnished under separate specifications and laid and terminated by the owner, the contractor shall check out the operation of all control systems for the equipment furnished and installed under these specifications and documents. The contractor shall get the drawings pertaining to the control system, power supply etc. approved from Directorate General of Mine Safety (DGMS) or any other appropriate authority as necessary, wherever required as per the rules and regulations of the of Indian Mines Act governed by D.G.M.S.

37.0 COMMISSIONING SPARES

The contractor shall make arrangement for an adequate inventory at site of necessary commissioning spares prior to commissioning of the equipment furnished and erected so that
any damage or loss during this commissioning activities necessitating the requirements of spares will not come in the way of timely completion of the works under the contract.

38.0 CABLEING

38.1 All cables shall be supported by conduits or cable tray run in air or in cable channels. These shall be installed in exposed runs parallel or perpendicular to dominant surfaces with right angle turn made of symmetrical bends or fittings. When cables are run on cable trays, they shall be clamped at a minimum interval of 2000 mm or otherwise as directed by the engineer.

38.2 Each cable, whether power or control, shall be provided with a metallic or plastic of an approved type, bearing a cable reference number indicated in the cable and conduit list (prepared by the contractor), at every 5 metre run or part there of and at both ends or the cable adjacent to the terminations. Cable routing is to be done in such a way that cables are accessible for any maintenance and for easy identification.

38.3 Sharp bending and kinking of cables shall be avoided. The minimum radii for PVC insulated cables 1100 V grade shall be 15D, where D is the over all diameter of the cable. Installation of other cables like high voltage, coaxial, screened, compensating, mineral insulated shall be in accordance with the cable manufacturer's recommendations. Wherever cables cross roads and water, oil, sewage or gas lines, special care should be taken for the protection of the cables in designing the cable channels.

38.4 In each cable run some extra length shall be kept at a suitable point to enable one to two straight through joints to be made should the cable develop fault at a later date.

38.5 Control cable terminations shall be made in accordance with wiring diagrams, using identifying codes subject to engineer's approval. Multicore control cable jackets shall be removed as required to train and terminate the conductors. The cable jacket shall be left on the cable, as far as possible, to the point of the first conductor branch. The insulated conductors from which the jacket is removed shall be neatly twined in bundles and terminated. The bundles shall be firmly but not tightly tied utilising plastic or nylon ties or specially treated fungus protected cord made for this purpose. Control cable conductor insulation shall be securely and evenly cut.

38.6 The connectors for control cables shall be covered with a transparent insulating sleeve so as to prevent accidental contact with ground or adjacent terminals and shall preferably terminate Elmex terminals and washers. The insulating sleeve shall be fire resistant and shall be long enough to over-pass the conductor insulation. All control cables shall be fanned out and connection made to terminal blocks and test equipment for proper operation before cables are corded together.
SECTION – 6

MISCELLANEOUS FORMS

CONTENTS

FORMS OF SECURITY
FORM OF BANK GUARANTEE
FORM OF ARTICLE OF AGREEMENT

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SECTION - 6

BANK GUARANTEE

PROFORMA FOR EARNEST MONEY DEPOSIT/BID SECURITY

(TO BE STAMPED IN ACCORDANCE WITH STAMP ACT)

(TO BE ISSUED BY ANY NATIONALISED/ SCHEDULED BANK AUTHORISED BY RBI TO ISSUE A BANK GUARANTEE)

To :

Bharat Coking Coal Limited,
P.O. : Koyla Bhawan,
Dist : Dhanbad ( Jharkhand)

WHEREAS ______________________ [name and address of Bidder] (hereinafter called “the Bidder”) shall be submitting its Bid dated _______________ [date of the Bid] for the work.

__________ [name of the work] (hereinafter called “the Bid”).

KNOW ALL MEN by these present that we, _____________________ [name of the bank] of ______________ [name of the country] _____________________ having our registered office at ................. [address of the bank] (hereinafter called “the bank”), are bound unto the Bharat Coking Coal Limited, Koyla Bhawan Complex, Dhanbad, Jharkhand (hereinafter called “the Employer”) for the sum of _______ [amount of the Guarantee in words and figures] for which payment well and truly to be made to the said Employer the Bank binds itself, his successors and assigns by these presents.

SEALED with the Common Seal of the said bank this ___________ day of _________ 200_.

THE CONDITION of this obligation are :

1. If the Bidder withdraws its Bid during the period of Bid Validity specified by the Employer on the bid form ; or

2. If the Bidder withdraws having been notified of the acceptance of its bid by the Employer during the period of Bid Validity :

   (a) Fails or refuses to execute the Contract Agreement when required ; or

   (b) Fails or refuses to furnish the Performance Security (if any) in accordance with the Bid conditions.

We, ______________ [name of the bank] undertake to pay to the Employer up to the above amount upon receipt of its first written demand, without the Employer having to substantiate its demand, provided that in its demand the Employer will note that the amount claimed by it is due to it owing the occurrence of 1 or both of the 2 (a) or (b) specifying the occurred condition or conditions.

This guarantee will remain in full force up to and including the date ___________________ and any demand in respect thereof should reach the Bank not later than the date of expiry of this guarantee.

For and on behalf of the Bank.

Signature __________________________
Name __________________________
Designation __________________________
Common Seal of Bank __________________________
BANK GUARANTEE PROFORMA FOR MOBILISATION ADVANCE

(TO BE STAMPED IN ACCORDANCE WITH STAMP ACT)

(TO BE ISSUED BY ANY NATIONALISED/SCHEDULED BANK
AUTHORIZED BY RBI TO ISSUE A BANK GUARANTEE)

To :

Bharat Coking Coal Limited.,
P.O. : Dhanbad,
Dist. : Dhanbad (Jharkhand.)

In consideration of the Bharat Coking Coal Koyla Bhawan Complex, Dhanbad, Jharkhand (hereinafter called to as the “Employer” which expression shall unless repugnant to the context or meaning thereof, include all successors, administrators and assigns) having awarded to _______________________________[Name & Address of the Contractor] (hereinafter called to as “Contractor” which expression shall unless repugnant to the context of meaning thereof include its successors, administrators, executors and assigns) the work ___________________[Name of the Work] by issue of Letter of Award No. _______________[Work Order/Letter on Intent No.] and the same having been unequivocally accepted by the Contractor resulting into a Contract Agreement dated _______________________[Date of Contract] valued at _______________[value of Work Order] (hereinafter called ‘the Contract’) and the Employer having agreed to make a Mobilisation Advance payment with interest to the Contractor amounting to _______________[Amount of guarantee in words and figures] for execution of the said Contract as an advance against Bank Guarantee of equivalent amount furnished by the Contractor.

We, _____________________ [Name of the Bank] of ___________________[address of the Bank] (hereinafter called to as ‘the Bank’ which expression shall unless repugnant to the context of meaning thereof, include all successors, administrators and assigns) do hereby undertake to pay to the said Employer on demand an amount not exceeding _______________[amount of guarantee in words and figures] against any loss or damage caused to or suffered or would be caused to or suffered by the said Employer by reasons of any breach by the said Contractor of any terms and conditions contained in the said Contract without any demure reservation, recourse, contest or protest and/or without any reference to the Contractor. Any such demand made by the Employer on the Bank shall be conclusive and binding notwithstanding any difference between the Employer and the Contractor or any dispute pending before any court, tribunal, arbitrator or any other authority. We agree that the guarantee herein contained shall be irrevocable and shall continue to be enforceable till the advance amount is liquidated.

The Employer shall have the fullest liberty without affecting in way the liability of the Bank under this Guarantee from time to time to vary the advance or to extend the time for performance of the Contract by the Contractor. The Employer shall have the fullest liberty without affecting this Guarantee to postpone from time to time the exercise of any powers vested in them or of any right which they might have against the Contractor and the exercise the same at any time in any manner and either to enforce or to forebear to enforce any covenants contained or implied in the Contract, between the Employer and the Contractor or any other course or remedy or security available to the Employer. The Bank shall not be released of its obligations under these presents by an exercise by the Employer of its liberty with reference to matter aforesaid or any of them or by reason of any other act of forbearance or any of them or by reason of any other act of forbearance or other acts of omission or commission on the part of the Employer or any other indulgence shown by the Employer or any other matter or thing whatsoever which under law would, but for this
provision, have the effect of relieving the Bank. The Bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a Principal debtor in first instance, without proceeding against the Contractor and notwithstanding any security or other Guarantee that the Employer may have in relation to the Contractor’s liabilities.

Dated this ________________ day of ___________________ at ________________

For and on behalf of the Bank.

Signature __________________________________________

Name __________________________________________

Designation _______________________________________

Common Seal of Bank __________________________________________
BANK GUARANTEE PROFORMA FOR PERFORMANCE SECURITY/GUARANTEE

(TO BE STAMPED IN ACCORDANCE WITH STAMP ACT)

(TO BE ISSUED BY ANY NATIONALISED/SCHEDULEDBANK
AUTHORISED BY RBI TO ISSUE A BANK GUARANTEE)

To:

Bharat Coking Coal Limited.,
P.O. : Dhanbad,              Dist. :
Dhanbad (Jharkhand.)

In consideration of the Bharat Coking Coal Limited, having its Registered office at P.O. Koyla Bhawan , Dist. Dhanbad (Jharkhand.) (hereinafter called to as the “Employer” which expression shall unless repugnant to the context or meaning thereof, include all successors, administrators and assigns) having awarded to ___________________ [Name & Address of the Contractor] (hereinafter called to as “Contractor” which expression shall unless repugnant to the context or meaning thereof include its successors, administrators, executors and assigns) the work ___________________ [Name of the Work] by issue of Letter of Award No. ________________ [Work Order/Letter of Intent No.] and the same having been unequivocally accepted by the Contractor resulting into a Contract Agreement dated _______________ valued at ___________________ [value of Work Order] (hereinafter called ‘the Contract’) and the Employer having agreed to accept Performance Bank Guarantee of ___ [indicate figure]% of the Contract Sum _______________ [amount in figures and words] from a Nationalized/Scheduled Bank for due performance of the work executed by the Contractor as per the terms & conditions contained in the said Contract.

We, ___________________ [name of the Bank], of ___________________ [address of the Bank] (hereinafter called to as “Bank” which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns) do hereby guarantee and undertake to pay the Employer immediately on demand and/or, all money payable by the Contractor to the extent of ___________________ [amount of guarantee in figures and words], at any time from _______________ to _______________ without any demur, reservation, recourse, contest or protest and/or without any reference to the Contractor. Any such demand made by the Employer on the Bank shall be conclusive and binding notwithstanding any difference between the Employer and the Contractor or any dispute pending before any Court, Tribunal, Arbitrator or any other authority. We agree that the Guarantee herein contained shall be irrecoverable and shall continue to be enforceable as per the terms & conditions contained in the said Contract.

The Employer shall have the fullest liberty without affecting in any way the liability of the Bank under this Guarantee, from time to time, to extend the validity of time of Performance of the Contract by the Contractor. The Employer shall have the fullest liberty without affecting this Guarantee, to postpone, from time to time, the exercise of any powers vested in them or of any right which they might have against the Contractor, and to exercise the same at any time in any manner, and either to enforce or to forebear or to enforce any covenants contained or implied in the Contract, between the Employer and the Contractor or any other course or remedy or security available to the Employer. The Bank shall not be released of its obligations under these presents by any exercise by the Employer of its liberty with reference to matter aforesaid or any of them or by reason of any other act of
forbearance or other acts of omission or commission on the part of the Employer or any other indulgence shown by the Employer or by any other matter or thing whatsoever which under law would, but for this provision, have the effect of relieving the Bank. The Bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a Principal Debtor in first instance, without proceeding against the Contractor and notwithstanding any security or other Guarantee that the Employer may have in relation to the Contractor’s liabilities.

Dated this ______________ day of ______________ at __________________

For and on behalf of the Bank.

Signature ________________________________

Name ________________________________

Designation ________________________________

Common Seal of Bank ________________________________
Agreement No.

Dated:

THIS ARTICLE OF AGREEMENT made on this ___________________ day of _________ 200_ between the Bharat Coking Coal Limited, a Employer registered under the Indian Companies Act. 1956 with its registered office at Dhanbad and a Subsidiary of Coal India Limited, Govt. of India Undertaking, P.O. Dhanbad (Pin-826005) Dist. : Dhanbad (Jharkhand), (hereinafter referred to as the Employer which expression where the context so admit shall include its successors in interest and assign) of the one Part and _________________________________________ (hereinafter referred to as “the Contractor” which expression where the context so admit shall include its heirs, executors, administrators legal representatives, successors in business and assign) of the other part.

WHEREAS, the Employer invited bid for the Work “ _____________________________  ” and the bid of the Contractor has been accepted by the Employer vide their Letter No ________________ dt. _____________________ for a sum of ____________________________ [Contract sum in figure & words]

WHEREAS the Contractor has agreed to execute the works on the terms & conditions as stipulated in the Bid and subsequent amendments thereto for a sum of ____________________________ [Contract sum in figure & words] for successful completion of the work.

NOW THIS AGREEMENT WITNESSETH AND IT IS HEREBY AGREED AS FOLLOWS:

1. In pursuance of the Agreement aforesaid and in consideration for the payment of the sum of ____________________________ [Contract sum in figure & words] and/or such sum as may be payable to the contractor, the Contractor shall upon and subject to the said terms & conditions execute and complete the work shown upon in the said drawings and described in the said scope of work as provided for in the said conditions.

2. The time shall be considered as one of the essence of the contract and time for completion of the contract shall be 36 (Thirty Six) months from the date of commencement of work.

3. The parties hereto shall respectively and faithfully abide by and submit themselves to the terms & conditions and stipulations contained in this agreement and perform and discharge their part of contract accordingly.

4. This final Agreement has been arrived at between the parties after due consideration of the correspondences, documents, meetings and negotiations held from time to time. The following documents shall constitute the Contract between the Employer and the Contractor. And each shall be read and construed as an integral part of the Contract
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<tr>
<th>Part</th>
<th>Description of Documents</th>
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<tbody>
<tr>
<td>1.</td>
<td>Article of Agreement.</td>
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<td>2.</td>
<td>Detailed Bid Notice.</td>
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<td>3.</td>
<td>Notification of Award</td>
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<td>4.</td>
<td>The Bid and Prices Schedules submitted by the Contractor</td>
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<tr>
<td>5.</td>
<td>Conditions of Contract</td>
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<td>5.</td>
<td>Financial terms and conditions</td>
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<td>6.</td>
<td>Billing Schedule</td>
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<td>7.</td>
<td>Technical Specifications and drawings</td>
</tr>
<tr>
<td>8.</td>
<td>Any Other Documents</td>
</tr>
</tbody>
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5. The Contract shall be executed within the purview of the Indian Laws.

In witness whereof the parties hereto have hereunder affixed their signatures at Dhanbad on the day, month and year written as above.

**SIGNED, SEALED AND DELIVERED**

<table>
<thead>
<tr>
<th>Signed on behalf of the Contractor</th>
<th>Signed on behalf of the Employer</th>
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</thead>
<tbody>
<tr>
<td>Designation</td>
<td>Designation</td>
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<td>Bharat Coking Coal Limited.</td>
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<td>P.O. : Dhanbad, Dist. : Dhanbad</td>
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<td>(Jharkhand.)</td>
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<td>Pin : 826005</td>
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In the presence of

WITNESS - 1  
(Signature)  
(Name in Block Letters)  
Official Address:

WITNESS - 2  
(Signature)  
(Name in Block Letters)  
Official Address:
18. INTEGRITY PACT

Between

BHARAT COKING COAL LIMITED (BCCL) hereinafter referred to as “The Principal”

And

…………………………………..hereinafter referred to as “The Bidder/Contractor”
**Preamble**

The Principal intends to award, under laid down organizational procedures, contract/s for -------------------------------. The Principal values full compliance with all relevant laws and regulations, and the principles of economic use of resources, and of fairness and transparency in its relations with its Bidder/s and Contractor/s.

In order to achieve these goals, the Principal cooperates with the renowned international Non-Governmental Organisation “Transparency International” (TI). Following TI’s national and international experience, the Principal will appoint an external independent Monitor who will monitor the tender process and the execution of the contract for compliance with the principles mentioned above.

**Section 1 – Commitments of the Principal**

(1) The Principal commits itself to take all measures necessary to prevent corruption and to observe the following principles:-

1. No employee of the Principal, personally or through family members, will in connection with the tender for, or the execution of a contract, demand, take a promise for or accept, for him/herself or third person, any material or immaterial benefit which he/she is not legally entitled to.

2. The Principal will, during the tender process treat all Bidders with equity and reason. The Principal will in particular, before and during the tender process, provide to all Bidders the same information and will not provide to any Bidder confidential/additional information through which the Bidder could obtain an advantage in relation to the tender process or the contract execution.
3. The Principal will exclude from the process all known prejudiced persons.

(2) If the Principal obtains information on the conduct of any of its employees which is a criminal offence under the relevant Anti-Corruption Laws of India, or if there be a substantive suspicion in this regard, the Principal will inform its Vigilance Office and in addition can initiate disciplinary actions.

**Section 2 – Commitments of the Bidder/Contractor**

(1) The Bidder/Contractor commits itself to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the tender process and during the contract execution.

1. The Bidder/Contractor will not, directly or through any other person or firm, offer, promise or give to any of the Principal’s employees involved in the tender process or the execution of the contract or to any third person any material or immaterial benefit which he/she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the tender process or during the execution of the contract.

2. The Bidder/Contractor will not enter with other Bidders into any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelisation in the bidding process.
3. The Bidder/Contractor will not commit any offence under the relevant Anti-corruption Laws of India; further the Bidder/Contractor will not use improperly, for purposes of competition or personal gain, or pass on to others, any information or document provided by the Principal as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.

4. The Bidder/Contractor will, when presenting his bid, disclose any and all payments he has made, is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the contract.

(2) The Bidder/Contractor will not instigate third persons to commit offences outlined above or be an accessory to such offences.

Section 3 – Disqualification from tender process and exclusion from future contracts

If the Bidder, before contract award has committed a transgression through a violation of Section 2 or in any other form such as to put his reliability or credibility as Bidder into question, the Principal is entitled to disqualify the Bidder from the tender process or to terminate the contract, if already signed, for such reason.
1. If the Bidder/Contractor has committed a transgression through a violation of Section 2 such as to put his reliability or credibility into question, the Principal is entitled also to exclude the Bidder/Contractor from future contract award processes. The imposition and duration of the exclusion will be determined by the severity of the transgression. The severity will be determined by the circumstances of the case, in particular the number of transgressions, the position of the transgressions within the company hierarchy of the Bidder and the amount of the damage. The exclusion will be imposed for a minimum of 6 months and maximum of 3 years.

2. The Bidder accepts and undertakes to respect and uphold the Principal’s absolute right to resort to and impose such exclusion and further accepts and undertakes not to challenge or question such exclusion on any ground, including the lack of any hearing before the decision to resort to such exclusion is taken. This undertaking is given freely and after obtaining independent legal advice.

3. If the Bidder/Contractor can prove that he has restored/recouped the damage caused by him and has installed a suitable corruption prevention system, the Principal may revoke the exclusion prematurely.

4. A transgression is considered to have occurred if in light of available evidence no reasonable doubt is possible.

**Section 4 – Compensation for Damages**

1. If the Principal has disqualified the Bidder from the tender process prior to the award according to Section 3, the Principal is entitled to demand and recover from the Bidder liquidated damages equivalent to 3 % of the value of the offer or the amount equivalent to Earnest Money Deposit/Bid Security, whichever is higher.
2. If the Principal has terminated the contract according to Section 3, or if the Principal is entitled to terminate the contract according to section 3, the Principal shall be entitled to demand and recover from the Contractor liquidated damages equivalent to 5% of the contract value or the amount equivalent to Security Deposit/Performance Bank Guarantee, whichever is higher.

3. The bidder agrees and undertakes to pay the said amounts without protest or demur subject only to condition that if the Bidder/Contractor can prove and establish that the exclusion of the Bidder from the tender process or the termination of the contract after the contract award has caused no damage or less damage than the amount or the liquidated damages, the Bidder/Contractor shall compensate the Principal only to the extent of the damage in the amount proved.

Section 5 – Previous transgression

1. The Bidder declares that no previous transgression occurred in the last 3 years with any other Company in any country conforming to the TI approach or with any other Public Sector Enterprise in India that could justify his exclusion from the tender process.

2. If the Bidder makes incorrect statement on this subject, he can be disqualified from the tender process or the contract, if already awarded, can be terminated for such reason.

Section 6 – Equal treatment of all Bidders/Contractor/Subcontractors

1. The Bidder/Contractor undertakes to demand form all subcontractors a commitment in conformity with this Integrity Pact, and to submit it to the Principal before contract signing.
2. The Principal will enter into agreements with identical conditions as this one with all Bidders, Contractors and Subcontractors.

3. The Principal will disqualify from the tender process all bidders who do not sign this Pact or violate its provisions.

Section 7 – Criminal charges against violating Bidders/Contractors/Subcontractors

If the Principal obtains knowledge of conduct of a Bidder, Contractor or Subcontractor, or of an employee or a representative or an associate of a Bidder, Contractor or Subcontractor, which constitutes corruption, or if the Principal has substantive suspicion in this regard, the Principal will inform the Vigilance Office.

Section 8 – External Independent Monitor/Monitors

(three in number depending on the size of the contract)

(to be decided by the Chairperson of the Principal)

1. The Principal appoints competent and credible external independent Monitor for this Pact. The task of the Monitor is to review independently and objectively, whether and to what extent the parties comply with the obligations under this agreement.

2. The Monitor is not subject to instructions by the representatives of the parties and performs his functions neutrally and independently. He reports to the Chairperson of the Board of the Principal.
3. The Contractor accepts that the Monitor has the right to access without restriction to all Project documentation of the Principal including that provided by the Contractor. The Contractor will also grant the Monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his project documentation. The same is applicable to Subcontractors. The Monitor is under contractual obligation to treat the information and documents of the Bidder/Contractor/Subcontractor with confidentiality.

4. The Principal will provide to the Monitor sufficient information about all meetings among the parties related to the Project provided such meetings could have an impact on the contractual relations between the Principal and the Contractor. The parties offer to the Monitor the option to participate in such meetings.

5. As soon as the Monitor notices, or believes to notice, a violation of this agreement, he will so inform the Management of the Principal and request the Management to discontinue or heal the violation, or to take other relevant action. The monitor can in this regard submit non-binding recommendations. Beyond this, the Monitor has no right to demand from the parties that they act in a specific manner, refrain from action or tolerate action.

6. The Monitor will submit a written report to the Chairperson of the Board of the Principal within 8 to 10 weeks from the date of reference or intimation to him by the ‘Principal’ and, should the occasion arise, submit proposals for correcting problematic situations.

7. Monitor shall be entitled to compensation on the same terms as being extended to/provided to Outside Expert Committee members/Chairman as prevailing with Principal.

8. If the Monitor has reported to the Chairperson of the Board a substantiated suspicion of an offence under relevant Anti-Corruption Laws of India, and the
Chairperson has not, within reasonable time, taken visible action to proceed against such offence or reported it to the Vigilance Office, the Monitor may also transmit this information directly to the Central Vigilance Commissioner, Government of India.

9. The word ‘Monitor’ would include both singular and plural.

Section 9 – Pact Duration

This Pact begins when both parties have legally signed it. It expires for the Contractor 12 months after the last payment under the respective contract, and for all other Bidders 6 months after the contract has been awarded.

If any claim is made/ lodged during this time, the same shall be binding and continue to be valid despite the lapse of this pact as specified above, unless it is discharged/determined by Chairperson of the Principal.

Section 10 – Other provisions

1. This agreement is subject to Indian Law. Place of performance and jurisdiction is the Registered Office of the Principal, i.e. Dhanbad (Jharkhand)

2. Changes and supplements as well as termination notices need to be made in writing. Side agreements have not been made.

3. If the Contractor is a partnership or a consortium, this agreement must be, signed by all partners or consortium members.

4. Should one or several provisions of this agreement turn out to be invalid, the remainder of this agreement remains valid. In this case, the parties will strive to come to an agreement to their original intentions.
5. _____________________

_________________________

For the Principal

Place: ……………………

Date: ……………………

For the Bidder/Contractor

Witness 1: ……………………………

Witness 2: ……………………………
TENDER DOCUMENT
FOR
DESIGN, SUPPLY, ERECTION, COMMISSIONING AND TESTING
OF
COAL HANDLING PLANT & SILO (5.0 Mtpa)
NEAR
MAHESHPUR SIDING
AT
BHARAT COKING COAL LIMITED, DHANBAD
PART-II
TECHNICAL SPECIFICATION

Bharat Coking Coal Ltd.
(A Subsidiary of Coal India Ltd.)
Koyla Bhawan Complex, Dhanbad- 826005 (Jharkhand)
<table>
<thead>
<tr>
<th>Vol.</th>
<th>Description</th>
<th>Section</th>
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<tr>
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<td>Sub-Section-7.1</td>
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<td>2. System Description &amp; Basic Data</td>
<td>Sub-Section-7.2</td>
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<td></td>
<td>3. Scope of Supply &amp; Works</td>
<td>Sub-Section-7.3</td>
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<tr>
<td></td>
<td>4. Technical Specifications</td>
<td>Sub-Section-7.4</td>
</tr>
<tr>
<td></td>
<td>5. Data Sheet</td>
<td>Sub-Section-7.5</td>
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<td><strong>Tender Drawings</strong></td>
<td>Section-8</td>
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**TECHNICAL SPECIFICATION**

*(MECHANICAL, ELECTRICAL & CIVIL)*

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<th>Sl.no</th>
<th>Description</th>
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<td>3</td>
<td>Sub-Section-7.3: Scope of supply and works</td>
<td>13-96</td>
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<td>4</td>
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<td>Sub-Section-7.5.1: Datasheet-Mechanical</td>
<td>562-585</td>
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<td>Sub-Section-7.5.2: Datasheet-electrical</td>
<td>586-605</td>
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<td>611-618</td>
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</tbody>
</table>
SUB-SECTION-7.1

PREAMBLE
1.0 Location

The proposed site for Silo loading arrangement near Maheshpur siding within the surface limit of Block-III OCP is located in Dhanbad district of Jharkhand and forms a part of Bharat Coking Coal Limited. The Block III OCP covers an area of about 14 sq. kms between latitudes 23° 46’23" N to 23° 48’34"N and longitude of 86° 12’46" E to 86° 15’36"E as per Survey India Report No. 7351/2 and contains large reserves of quarriable coal due to occurrence of flat, thick and multiple seams.

2.0 Communication

Block-III opencast mine is located in Dhanbad district of Jharkhand and forms a part of Bharat Coking Coal Limited. Dhanbad railway station on the Chord line is located at a distance of about 32 kms from the centre of the property and Khanudih Railway station is at a distance of about 7-8 kms from the site of this proposed CHP with Silo loading system and also Ring road connected to high way passes at a distance of 8 kms from the project which is connected by a Jeepable road. The nearest town Katras is about 6 kms and Dhanbad is approx 32 kms from the project.

3.0 Physiography

Block III OCP is located in the south western portion of Jharia Coalfield. The block is continuous and adjoining to Block IV located in the east of the existing Block III OCP. It stands out as high plateau over the talcher plains in the south with the maximum elevation of about 200 m above Mean Sea Level. North of Railway track leading towards Barora siding adjoining to the site for this arrangement is Kalijore. The existing area for this site proposed for silo loading arrangement is almost a flat terrain. The proposed site is cut across by a nala (Kalijore) used as a natural drainage of the entire catchment area during rainfall which is having a depression of around 2-5 meters.
4.0 Climate

The climate is tropical with hot summer. The temperature during summer goes as high as 46°C in May-June. In winter (November to February) the temperature varies from 4°C to 21°C. Predominant wind direction is South-West. The average velocity of wind varies from 2.5 to 4.5 Kms per hour. The average annual rainfall is about 1600mm of which 90% of the precipitation is during rainy season (June-Sept).

5.0 About this tender

It is proposed to install a Rapid loading system through Silo for fast evacuation of coal. The production programme and linkages/evacuation system for the year 2012-13 and 2016-17 (year in which projects will achieve its planned capacities) are given below:

<table>
<thead>
<tr>
<th>Production in MTY</th>
<th>Linkages/Evacuation System</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2012-13</td>
</tr>
<tr>
<td>Coking</td>
<td>0.55</td>
</tr>
<tr>
<td>Non-linked Washery</td>
<td>7.40</td>
</tr>
<tr>
<td>Non-Coking</td>
<td>5.10</td>
</tr>
<tr>
<td>Total</td>
<td>13.05</td>
</tr>
</tbody>
</table>

As shown in the table above, Block-II coal shall be linked to existing Coking and proposed 5 MTY NLW washeries, the proposed Rapid loading system will cater to the need of Block-III and Block-IV which are well connected by road and falls at the quick evacuation and less environmental impact.

The mines of BCCL are proposed to be clustered to form blocks which are to be worked in stages for achieving the annual production target of BCCL. As per the annual production programme envisaged in planning schedule of BCCL, the planned capacities for Block-II, Block-III and Block IV has been proposed as 5.0 MTY, 8.0 MTY and 6.0 MTY respectively. As such, the combined production of above three blocks will be 19.0 MTY. Out of this combined production of 19.0 MTY, 2.80 MTY is coking coal, 6.42 MTY is non-coking coal and 9.78 MTY is linked washery coal. Coking coal 2.80 MTY is linked to coking coal washeries of BCCL, Linked washery coal 8.0 MTY will be routed through proposed new washeries (5.0 MTY in the report of “Selection of site for setting up non-coking coal washery at BCCL” and 3.0 MTY in another proposed new washery at Madhuband). Balance 1.78 MTY linked washery coal is proposed to be routed through feeder breakers for sizing at Tundu siding which is to be revived. Out of 6.42 MTY non-coking coal, 5.0 MTY will be linked to Silo arrangement near Maheshpur siding and to be despatched through road.
The quality of the coal is power grade and it will be supplied to power houses through Indian Railways loading by means of Rapid loading system. The ROM coal shall be crushed down to (-)100 mm size before it is dispatched through Indian Railways to power houses.

Sufficient storage has been provided in the coal handling system to meet the eventualities of disrupted coal production in the mine or delay in off-take by Indian Railways.

Considering the fact for which a very high tonnage of coal has to be dispatched within the stipulated time, a rapid loading system with automatic sampler for loading into railway wagons has been adopted.

The coal handling plant shall have facilities for receiving coal from tippers of 25T capacity, crushing of coal to (-)100 mm size, conveying, storing, reclamation and loading into railway wagons. The coal handling plant has also been provided with suitable fire fighting, automatic sampling arrangement and communication facilities.

This tender document is for construction of Coal Handling Plant on turnkey basis. The scope of this tender broadly includes approach road and construction of receiving arrangement and crushing of ROM coal, storage of crushed coal in a self flowing above ground bunker, rapid loading system, dust suppression and extraction, fire fighting, automatic coal sampling etc. The plan showing the location of the CHP is given on the drawing bearing No.RI-2/E&M/100026

In case of any contradiction amongst these parts/ sections of the Bidding Documents, the Owner should be contacted for clarification. Also where there are discrepancies in text and drawings, the data given in the text is to be followed. All the equipment and facilities are to be supplied by the successful bidder within the estimated time period. All equipment/ systems shall be designed, fabricated and selected as per relevant Indian standard/ international standards and up to date engineering practices and necessary inspections / test certificates shall be submitted along with equipment supply to certify the quality and genuineness of critical components and capacity and other technical parameters of the equipment/ systems.
SUB-SECTION-7.2

SYSTEM DESCRIPTION AND BASIC DATA
1.0 System Capacity

The system capacity of the coal handling plant shall be designed in such a way so that it can cater to fluctuations in the coal production within an overall rated production of 5.00 Mtpa. from the quarry. A circuit consisting of Single roll crushers for primary crushing and coal sizer for secondary crushing, Apron feeders, Rock breaker equipment of through-put capacity of 1200TPH and the circuit for reclaiming from storage bunker upto silo of capacity 2x1200 TPH have been envisaged. Such circuits comprising of crushing and conveying of coal upto a storage bunker of 10,000 t capacity have been envisaged with one circuit and circuit for reclaiming coal upto silo have been envisaged with two circuit. The capacity of silo for wagon loading has been kept as 4000 t. Layout of the CHP is shown in drawing no RI-2/E&M/200033.

2.0 Storage

A self-flowing above ground storage bunker of 10000 t capacity has been envisaged to take care of any irregularity in the off take schedule of railways. This combined storage capacities of above ground bunker & Silo are equal to the capacity of 14000 MT. The daily output from this CHP has been planned for 17000 MT.

3.0 Loading

On an average five rakes of roughly 3700 tonne capacity will be loaded per day. Thus with the loading rate of 5500 tph enough time will be available to load five rakes in a day.

4.0 Silo

A concrete silo of 4000 tonne self flowing capacity with two nos of pre-weigh hopper has been envisaged. 4000 tonne silo together with a reclaim capacity of 2400 tph, using both the circuits from below the bunker, will be sufficient to load rakes of 58 BOX ‘N’ wagons within the stipulated time.

5.0 Description of CHP

5.1 Receiving Arrangement & Crushing of ROM Coal

The ROM coal will be transported from the face by rear discharge dumper up to surface coal dump. Tipping trucks of 25 Te capacity will carry coal from coal dump and discharge coal into the receiving pit having the capacity 150 Te. The receiving pit will have grizzly over it. The grizzly will have the square opening to prevent lumps larger than 800 mm from falling the over size lumps which will be broken down to pass through the grizzly with the help of hydraulic rock breakers. Separate grab with overhead traveling arrangement will be used to remove over size stone pieces from the grizzly.
There will be two nos. of receiving pits. Both the receiving pits are having independent crushing sets forming by one single roll cruscher-1200 tph receives coal through one no apron feeder from receiving pit & discharges directly on to a twin shaft coal sizer of 1200 TPH capacity to size the coal at (-) 100 mm. After sizing (-)100mm the coal from the sizer at the rate of 1200 TPH will discharge into an elevating conveyor (C 1, 1400 mm width). Both the receiving pits are equipped with the same arrangement located parallel to each other & perpendicular to conveyor (C 1, 1400 mm width). There will be one belt conveyor (C 1 1400 mm) installed below the discharge points of both the coal sizers carrying crushed coal of desired size from the coal sizers, & to carry the same upto the transfer hopper of 50 Te capacity. Each of the receiving pits are totally equipped with crushers, apron feeders, grab attachments, rock breakers, magnetic separators, metal detectors etc. and other ancillary equipment.

5.2 Storage

The crushed coal of (-)100 mm will be discharged onto elevating conveyors C1 which in turn will discharge coal into a 50te overhead transfer hopper equipped with two nos of vibratory feeder at the discharge opening to feed the tripper conveyors C2 (1400 mm wide) for spreading coal throughout the bunker of 10,000 Te. Capacity. The bunker will be of double slit type and reclamation of coal will be done by rotary plough feeders each of 1200 TPH capacity. In each slit there will be two nos. of plough feeders of which one will be working and the other will be kept as a stand-by.

The plough feeders will reclaim coal from the bunker and discharge onto a pair of reclaim conveyors of 2X1200 tph capacity, 1400 mm width (C3&C4).

5.3 Loading & Wagon Movement

The conveyors C3&C4 will discharge coal into the silo. These conveyors will be of 1400 mm width, 1200 TPH capacity. These will load coal into the 4000 tone capacity silo. The silo will always remain full. The silo shall be equipped with two sets (one set to serve as standby) of rapid loading gates and chutes for loading into wagons. The silo shall be designed for mass-flow. The system shall consist of two sets of pre-weigh bin arrangements i.e. the required quantity of coal equivalent to the pay load capacity of the railway wagon will be discharged into the bin before it is discharged into the wagon. The weigh bin will be located just below the 4000 tone capacity silo. A rapid loading swing chute will be placed below the weigh bin to regulate and direct the flow of coal into wagons.

6.0 Dust Suppression & Extraction

Necessary measures for dust suppression, dust extraction and ventilation shall be provided at various places. Dust suppression arrangement shall be provided at dumper discharge point, bunker top and loading point. For plant safety and fire fighting dry type fire fighting equipment shall be provided. Fog system type dust suppression may be provided where ever it is possible.
7.0 Belt Weighing

One number of belt weighing scales has been envisaged in each out-by conveyor. These will be located on the conveyors C1, C3, C4.

8.0 Metal detectors and Magnetic separators

To protect the belt from damage by ferrous and non-ferrous materials metal detectors and magnetic separators have been provided in the coal handling plant. These devices shall be located at some suitable location so that belt can be protected from any damage. There shall be a common control room for all equipment in accordance with predetermined sequence for starting and stopping. But provision for local control of any equipment shall also be provided for emergency purpose. Sequence inter-locking between different equipment shall also be provided.

9.0 Brief description of works:

The tender is for construction of one stream of belt upto above ground storage bunker and two streams of belt from ground bunker to silo. The brief description of works is as under:

a) Approach road up to receiving pit.

b) Crushing complex comprising single roll crushers for primary crushing, coal sizer for secondary crushing, apron feeders and rock breaker, magnetic separators, EOT Crane and conveyor C1.

c) Transfer house-I, II & III - 1) Below the crusher house & discharge point of conveyor C1 & 2) At the discharge point of conveyor C2 which will discharge coal into a 50 te hopper equipped with two nos of vibratory feeders of 600 tph capacity each 3) At discharge point of conveyor (C3 & C4) to silo.

d) Two way chute at the tripper over the 10000 Te above ground bunker.

e) Tripper conveyors C2 to store coal into the 10000te bunker.

f) 10000 te above-ground bunker with plough feeders and reclaim/silo feed conveyors (C3 & C4)

g) 4000te Silo with high speed load out system, pre -weigh hopper.

h) Sampler and sample preparation house.

j) Dust control system.

k) Chutes & liners.

l) One no. electrical 6.6kv switching station at suitable site in between receiving pit & ground bunker.

m) Remote and sequential control of both the streams.
n) Illumination system in conveyor gantry; transfer houses and substations under the scope of work.

o) Total Communication system.

p) Necessary lifting tools and tackles and spot repair facilities.

q) Ventilation system for receiving pit and in MCC.

r) Status/condition monitoring devices.

s) Plant cleaning and drainage.

t) Design and engineering, erection and commissioning and associated civil and structural works with site office and rest rooms.

u) Drinking water and toilets, roads with lighting system and water supply system for fire fighting system.

v) Fire fighting system of both the streams of CHP. Water supply for both the stream shall be drawn from 300/600 m³ tanks. Necessary piping, pumps, valves, pump house, associated power supply system etc are within the scope of this work.

10.0 GENERAL

The tender is for construction of one stream of belt upto above ground storage bunker and two streams of belt from ground bunker to silo.

**Basic Data**

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<thead>
<tr>
<th>Description</th>
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<tr>
<td>Coal production to be routed through this system</td>
<td>5.00 Mtpa</td>
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<tr>
<td>No. Of working days considered/year</td>
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<td>No. Of working shifts/day</td>
<td>3</td>
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<tr>
<td>No. Of working hours/shift</td>
<td>8</td>
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<tr>
<td>Quality and other parameters of coal Grade</td>
<td>Grade A to G (Mixed)</td>
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<td>H.G.I.</td>
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<td>Capacity of tipping</td>
<td>25T Rear Discharge trucks</td>
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<td>Feed size of coal to the coal handling plant(mm)</td>
<td>(-) 1200 (Maximum)</td>
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<tr>
<td>Product size of coal (mm)</td>
<td>(-) 100 mm</td>
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<td>Consumer</td>
<td>Power Houses</td>
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<td>Mode of dispatch</td>
<td>Indian Railways</td>
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<td>Conveyor capacity upto bunker</td>
<td>1200tph</td>
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<tr>
<td>Conveyor capacity after bunker</td>
<td>2X1200tph</td>
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SUB-SECTION-7.3
SCOPE OF SUPPLY AND WORKS

1.0 GENERAL

1.1 This tender document for CHP with Silo Loading Arrangement near Maheshpur siding is for construction of approach road upto receiving pit and planning, design, engineering, manufacture, shop fabrication, assembly, testing, packing, transportation to site, insurance, delivery to site, receipt, unloading, handling, storage at site, fabrication at site, installation and erection including all civil, structural works and associated electrical & mechanical works and other allied auxiliary facilities such as ventilation, dust extraction & dust suppression system, drinking water supply system, fire fighting etc. for coal handling plant with silo loading arrangement.

1.2 The contract for the package will not be split. The contract will be treated as a combined contract.

1.3 The equipment and works mentioned hereinafter to be read in conjunction with preamble (Sub-Section-7.1), system description and basic data sheet (Sub-Section-7.2), and technical specification (Sub-Section-7.4) are indicative and not limited to the description and/or list given.

1.4 All mechanical & electrical equipment and systems and civil works are within the scope of supply and works of contractor.

2.0 Scope of Supply

2.1 Equipment, Accessories, Facilities and Spare Parts

2.1.1 List of mechanical equipment, accessories and facilities are given in Annexure-III.1.

List of conveyors and belting is given in Appendices-A and B respectively.

Location for installation of electric hoist & chain pulley blocks is given in Appendix-C

2.1.2 List of electrical equipment, accessories and testing equipment is given in Annexure-III.2

2.1.3 List of mandatory parts to be supplied by the contractor, is given in Annexure-III.3.

2.1.4 List of tools and tackles is given in Annexure-III.4.

3.0 Scope of works and services

3.1 The scope of work covers all the related civil and structural works, transportation, insurance, storage at site, erection and commissioning, performance tests,
Detailed engineering, PAT (Portable appliances testing) & FAT (Fixed appliances testing) and handing over of plant and includes but not limited to the following:

I. Construction of approach road upto receiving pit.

II. Design & engineering of all mechanical, electrical, civil and structural works of the plant.

III. Erection and commissioning of all the plant and equipment. Supervision at site and inspection and testing.

IV. Performance guarantee.

V. Any other works/services not mentioned but required for the completion and commissioning of the plant.

3.2 All the items and works specified in this document and any other equipment and work found necessary but omitted is deemed to have been covered in the scope of supply and works in the tender without any increase in the contract price.

3.3 Obtaining approvals from Weights and Measure Department is the responsibility of the bidder.

3.4 Air, water and noise levels shall be within the permissive limits as specified in the bid document. Additional requirement and stipulation by State/ Central Pollution Control Board, if any, on the subject shall also be applicable.

3.5 Adherence to Indian Standards

All the works including designs, drawings, construction, fabrication, testing, erection, etc. shall be done strictly as per Indian Standards. In absence of Indian standards, International standards like British, American, German or Russian may be used. A copy of the standard used shall be furnished along with the concerned drawing/document during approval.

3.6 The equipment list indicates only broad parameters and the accessories required for successful commissioning / operation of CHP shall be considered to be part of the total works. The other terms and conditions of works including technical, commercial, etc shall be governed by the clauses of the bid and contract.

3.7 The technical parameters to be furnished are subject to scrutiny/approval at the detailed design stage which may undergo minor changes keeping in view the system requirement and various codes of practices/regulation by the statutory bodies. This is also true for drawings. The parameters not specifically mentioned in the bid document shall be decided at the time of detailed engineering subject to owner's approval.

4.0 Details of works and services

4.1 Design Engineering

i) Elaboration and furnishing of system design/drawing, based on actual parameters of equipment to be supplied. The system design as proposed in the plant description shall form the basis of this elaboration.
ii) Preparation and furnishing of all relevant detailed engineering drawings based on elaborated system design drawing duly approved by consultant in writing. This includes fabrication, assembly, installation and erection drawings.

iii) Furnishing of detail design calculations in support of different design and equipment parameters.

iv) Furnishing of equipment specification supported by manufacturer's illustrative pamphlets and literature.

v) Furnishing of operational, maintenance and spare parts manual supported by the illustrative pamphlet and literature of manufacturers.

vi) All approved drawings and documents shall be supplied in six copies in addition to one copy in ink on polyester tracing paper of approved quality and one copy on CD. Final drawing/literature shall be presented in the form of document.

vii) All drawings shall comply with current Indian Standard specifications and shall be sufficiently detailed with dimensions and shall be clear and legible.

viii) The bidder shall submit detailed time schedule in the form of PERT NETWORK for complete plant and subsequently for each major activity for monitoring purpose. The same shall be updated from time to time. This is essential in view of maintaining time schedule. The successful bidder shall have to submit monthly/quarterly progress report of the various works being carried out.

ix) Provision of equipment (Motorised belt reeling drum) for belt erection/replacement and vulcanising during maintenance of conveyor belt shall be made available at site as per clause 4.3.3.

4.2 Erection and Commissioning

4.2.1 Erection & commissioning of tail end frame with drum, external cleaner, skirt board, intermediate structures, take-up, drive head including motor, gear box & couplings, discharge drum, conveyor rollers, single / two way discharge chute for conveyors, safety switches and laying of suitable belting and vulcanising of conveyors.

4.2.2 Erection & commissioning of single roll crusher for primary crushing and coal sizer for secondary crushing, Rock breaker, apron feeder, Rapid loading system, E.O.T Crane, belt weigher, magnetic separator, metal detector, chain pulley block, electric hoist, fire fighting system along with associated accessories and condition monitoring equipment. Erection and commissioning of dust extraction, dust suppression and ventilation equipment at different locations.

4.2.3 Construction of receiving hopper for installation of single roll crusher for primary crushing and coal sizer for secondary crushing & platform for apron feeder.
a) Receiving Hopper

Both the receiving hoppers shall be designed to receive feed from 25T rear discharge tippers. Dimensions mentioned in the drawing are only indicative. These may change at detailed design stage. The receiving hopper of 150 te capacity each shall be of RCC.

4.2.4 Installation of EOT crane shall be completed before both the crusher assemblies reach at site for erection.

4.2.5 Construction of 10000t overhead bunker of slit type for installation of plough feeder and tripper conveyors.

4.2.6 Transfer point-I,II&III

4.2.7 4000t silo with pre weigh-hopper consisting of hydraulic power pack, cylinders, guillotine type gates for high speed load out, arch breakers, load cells, wagon loading swing type chute and temperature sensors.

4.2.9 Rapid loading system

The loading will be done through rapid loading system on an average one wagon per minute. The loading shall be controlled from control room located at first floor of the silo. The rate of loading will be around 5500tph matching the creep speed of locomotive.

The rakes will be hauled by a creep controlled locomotive at 0.8 to 1.2 km/hr. Ultrasonic level indicators will be provided in the silo to show the coal level position. Air blasters shall be provided to avoid /break the arch formation inside the silo and to ensure smooth coal flow through the silo. The system shall have the switches for emergency stop of feed conveyors in case of over filling of silo. There shall be temperature sensors to indicate the abnormal temperature inside the silo and provide caution so that fire fighting measures can be taken up. A lift has also been envisaged.

To ensure better loading and weighing accuracy pre-weigh loading system shall be adopted. No separate wagon weighing system is required. There shall be two loading pockets over one rail track. Silo shall be provided with periodic inspection facilities.

4.2.10 Sampling system

For determining the quality of coal despatched by each rake there shall be provision of automatic sampling of coal, drum type, from the feed conveyors to the silo. The sampling system shall conform to BIS /ISO/ASTM specifications and shall consist of a primary sampler fitted to each in feed conveyor and a primary sample belt conveyor of min 650mm width to collect coal samples from the two separate sample discharge chutes and to convey the primary sampled coal to the sample preparation system.

4.3 Miscellaneous Systems

4.3.1 Safety devices

All the equipment and conveyors in the circuit shall be provided with necessary safety devices such as emergency stop switches, overload protection, wire-netting, railing type or guards, pull chords switches, belt sway switches, zero speed switches, brakes, holdback devices, etc wherever applicable. All equipment in both the streams will be started and stopped from the central control room in a pre-determined sequence consecutively i.e. one by one with a definite time lag.
The sequence of starting of drive will be in the reverse direction of coal flow, while stopping of the drives will be in the direction of coal flow. In case of stoppage of any equipment in the circuit for any reason, all the preceding equipment/conveyors shall be stopped automatically.

Pre-start hooters shall be blown to alarm the operating and maintenance personnel. All the floors and distant transfer houses shall be provided with audiovisual signals to alarm the working personnel locally. Necessary walkways and crossovers shall be provided along the conveyors. Under-netting shall be provided wherever conveyors cross any roads or working areas as elaborated elsewhere.

4.3.2 Pollution control

Dust suppression and extraction

Proper water supply arrangement for dust suppression and dust extraction will be made at dust generating points so that all working space remains free of dust. For dust suppression water jets will have to be provided in receiving pit area, silo loading point, transfer houses and dust extraction arrangements will be done at crushing stations. Alternatively, fog type dust suppression can also be used at critical location. For proper ventilation in all the working floors, arrangements for installing exhaust fans/ventilation fans with ducting will have to be made as detailed elsewhere in the tender document. All civil works pertaining to dust suppression and extraction shall be as per system requirement. Dust suppression system should be suitable for water which is available at Block-III OCP Project. The pumping sets for the dust suppression/ control should have 100% stand-by at each location. Necessary arrangements of infrastructure for reusing/recycling of used water should be made. Arrangement for rain water harvesting should be made for storage of water in lean periods.

Necessary measures shall also be taken for noise and vibration control.

4.3.3 Repair facilities

Necessary spot repair facilities shall be provided for plant and equipment including lifting tools and tackles. Provision for site storage of spares and tools shall also be made. All lubrication charging points shall be dust free. A drum of suitable diameter and slow speed drive arrangement shall be provided at each drive house of conveyor system. This will facilitate automatic changing of conveyor belt.

4.3.4 Chutes and liners

Chutes shall be designed for a smooth flow of coal and they shall be lined with suitable replaceable rubber liners. Wherever the flow of coal is likely to be obstructed due to moist nature of coal or due to long arm of chute, the facility of chute actuators shall be provided as specified. Conveyor chutes shall be carefully designed with respect to the coal trajectory to minimise impingement and wear on lining plates.

4.3.5 Drinking water and other facilities

Facilities for distribution of drinking water shall be provided all along the plant with provision of toilet facilities at suitable points as detailed in civil section.
4.3.6 Plant cleaning and drainage

4.3.6.1 Suitable arrangements shall be made for cleaning of plant especially at the spillage point with the help of water hydrants and vacuum cleaners in case of electrical panels and plant equipment.

4.3.6.2 Plant cleaning points shall be provided at each receiving pit complex, drive house, tail end, transfer points, above ground bunker and along all conveyors at a maximum interval of 50 metres. The effluent shall be discharged into a suitable location/ ETP by drainage or through pumps, pipes, etc. Compressed air points should be provided in the crusher house, and near the plough feeders for cleaning. These shall be served by portable compressors as envisaged in the bid document.

4.3.6.3 Water and compressed air pipe line net work along with connection/tapping points with control valves at suitable intervals shall be provided in the receiving pit floors, pent houses, transfer and drive houses, conveyor galleries, substations, above ground bunker etc. for pressure cleaning of floor chutes, walkways etc. Proper drainage arrangement will have to be made all along the plant so that water or slush accumulation is avoided. At every probable spillage point suitable arrangement will have to be made for mechanised or manual cleaning.

4.3.7 Fire fighting of total coal handling plant

Fire fighting system shall comprise of (a) hydrant system, (b) mobile fire extinguishers (c) water spray system comprising of automatic medium velocity water spray system (d) automatic sprinkler system and

Fire fighting system shall be designed to meet the various requirements laid down in the fire protection manual by the Tariff Advisory Committee (TAC), India and National Fire Alarm Code by NFPA (USA).

**Hydrant system:** The fire hydrant system shall be designed considering the entire plant generally as ordinary hazard as per TAC manual and shall consists of a net work of over ground piping feeding pressurised water to a number of double headed hydrant valves located through out the entire coal handling plant.

**Portable & Mobile Extinguishers:** Portable extinguishers of carbon dioxide type, dry powder type & soda acid/ DCP type shall be installed at suitable locations all along the plant as per TAC manual. Mobile extinguishers of required number shall be provided. Different types, as described above, shall conform to the latest BIS standards.

2.3.8 Ventilation

2.3.9 Proper ventilation system shall be provided at the top of receiving pit and as detailed in mechanical section.

4.3.9 Site office and rest room, etc

A site office of suitable size for engineers/supervisors and a rest room for workers shall be provided. Other service buildings shall be provided as detailed elsewhere and/or, as per requirement.
4.4 **ELECTRICAL**

The electrical works / equipment included in the scope of this package are listed below:

4.4.1 **6.6kV switching station** (Refer Drawing No. R2/E&M/000031 comprising the following):

- a) Two nos. single circuit 6.6kV OHT Line each of 4 km (Approx) in length with Wolf conductor and another section of single circuit 6.6 kV OHT line of 0.5 km (Approx) length with Wolf conductor covering total length – 8.5 Km
- b) 6.6 kV Lightning arrester – 6 sets.
- c) 6.6 kV Isolators with earthing switch – 6 sets.

4.4.2 **6.6 kV Switchboard Panel** comprising the following and associated equipment:

<table>
<thead>
<tr>
<th>Sl. no</th>
<th>Description of Panel</th>
<th>Feeder type</th>
<th>Qty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>6.6 kV Vacuum Circuit Breaker Panel</td>
<td>Incoming Feeder</td>
<td>2 no.</td>
</tr>
<tr>
<td>2.</td>
<td>6.6 kV Vacuum Circuit Breaker / contactor Panel</td>
<td>Outgoing feeder for Primary control of equipment &amp; transformers</td>
<td>16 nos.</td>
</tr>
<tr>
<td>3.</td>
<td>6.6 kV Vacuum Circuit Breaker Panel</td>
<td>Outgoing feeder cubicle for control of Capacitor</td>
<td>2 nos.</td>
</tr>
</tbody>
</table>

- a) 1000 kVA, 6.6 / 0.44 kV power distribution transformer for supply of power to LT loads -2 Nos.
- b) 6.6 / 0.44, 500 kVA power distribution transformer for supply of power to LT Loads – 2 nos
- c) 6.6 /0.440 kV, 3 phase 200kVA lighting transformers – 2 nos
- d) 6.6kV Capacitor Bank of required capacity – 2 nos
- e) Plant Illumination system covering illumination of switching station, Receiving pit complex, crusher house, Gantry of Conveyors, Drive House of conveyors, Transfer Houses and Outdoor illumination of adjacent area.
- f) Lightning Protection System for Switching-station and other structures having height of 10m and above.
- g) Solid earthing system of 6.6kV switching station and all the electrical equipment under this package.
- h) 220 V, Battery Bank and Charger
- i) 440/110V Transformer for AC control supply-4 nos.
- j) 440/110V Transformer for DC control supply with necessary inverter-4 nos.
- k) HT and LT Power, Lighting and Control cabling.
- l) Control Desk Cum Mimic Panel including Annunciation Panel for control of equipment of Ground Bunker Complex, Tripper Conveyor, Plough Feeders, Conveyors & Drive house of conveyors.
4.4.3 **Silo MCC I, II, III Room:**

440 V motor control centres for supply of powers to LT loads like apron feeders, EOT Cranes, Electric hoist, Dust suppressors, Magnetic detectors, trippers, Belt weighers, Fire fighting system, Conveyors brake, conveyors rated 110 kW and below ctc. comprising the following.

<table>
<thead>
<tr>
<th>Sl. no</th>
<th>Description of MCC modules</th>
<th>Feeder Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>440 V, Air circuit Breaker</td>
<td>incoming feeder for MCC-1 near crusher Complex/Receiving pit</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>440 V, Air circuit Breaker</td>
<td>Incoming feeder for MCC-II near Ground Bunker</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>440 V, Air circuit Breaker</td>
<td>Incoming feeder for MCC-III near SILO complex</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>440 V, Air circuit Breaker</td>
<td>Inter connection between MCC – I &amp; MCC - II</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>440 V LT motors controlling cubicles comprising Isolator, HRC fuses, contactor thermal over load relay with built-in single phase preventor</td>
<td>Outgoing feeder for control of LT motors as indicated in drawing R-2/E&amp;M/100004 for MCC-I,II,III</td>
<td>As required</td>
</tr>
<tr>
<td>6</td>
<td>440 V Bus coupler</td>
<td>For coupling of bus section of MCC-III bus</td>
<td>1</td>
</tr>
</tbody>
</table>

Ilumination system of Rapid loading Complex, adjacent areas and gantry of Sampler conveyor, etc.

Lightning Protection System for structures having height of 10 m and above.

Earthing system of all the electrical equipment covering electrical system for rapid loading complex, electrical equipment of conveyors Sampler conveyor, etc.

220 V, Battery Bank and Charger, if required.

Power, Lighting and Control Cabling.
Control Desk cum mimic panel and annunciation Panel for control of equipment of Rapid Loading Complex, Loading Conveyors and other miscellaneous electrical drives.

Control, automation, interlocks, Signalling and instrumentation of Rapid Loading complex including sequence operation of loading conveyors with silo level indicator and dove-tailing of sequence operation of Reclaim Conveyors with plough feeders below ground bunker.

4.4.4 The rating of equipment indicated in the drawings are minimum and bidder’s are required to assess the rating of equipment as per system requirement and quote accordingly.

4.4.5 The capacity of transformers are selected to cater the entire load of MCC in case of failure of power in any MCC.

4.4.6 Transformer capacity mentioned in the drawing is minimum capacity. Bidders shall make their own assessment and shall indicate higher capacity, if required. All the transformers including that of lighting shall be located indoor only

4.4.7 All the electrical installations shall be as per Indian Electricity Rules and DGMS Regulations. Approval of DGMS shall be obtained by the contractor along with submission of necessary Test certificates/drawings/circuit diagrams
4.4.8 SUPPLY OF CONTROL CIRCUITS/ CONTROL VOLTAGES

Auxiliary Control circuit & Contactor Coil of MCC : 110 V AC
Programmable Logic Control Circuit : 24 V DC

110 V AC shall be made available from control Transformer of required capacity. 220V DC shall be made available from Battery Bank and 24 V DC shall be made available from UPS system of required capacity.

4.4.9 METERING

4.4.9.1 Metering at 6.6 KV

(A) All the 6.6 KV incoming panels will be provided with following digital meter:
   i) Ammeter
      a. Voltmeter
      b. Power Factor Meter
      c. Tri-vector Meter

   All the outgoing 6.6 kV panels will be provided with Ammeter, kWh indicating meter.

(B) Metering at 0.440KV

All the 6.6/0. 440 KV incoming circuit breakers will be provided with following digital meters.
   Ammeter
   Voltmeter
   kW hr meter

All the 440 V outgoing modules of MCC controlling motor rated 22 kW and above will be provided with Ammeter.

4.4.10 PROTECTION

4.4.10.1 Protection at 6.6 KV

a) All the 6.6 kV incoming panels will be provided with over current, short circuit, earth fault and earth leakage and neutral displacement relays.

b) All the outgoing panels supplying power to HT motors will be provided with motor protection relay (MPR).

c) All the panels supplying power to transformers and capacitor banks will be provided with over current and short circuit protection.

d) All the outgoing HT panels will be provided with earth leakage protection by core balance transformer
(B) **Protection at 440 V**

a) All the incoming panels will be provided with over current, short circuit and earth leakage protection.

b) All the outgoing panels supplying power to motors will be provided with single phasing protection, Over Current, Short Circuit and Earth Leakage Protection.

c) Motors above 45 KW used in sequence control will have motor protection relay.

**4.4.11 POWER FACTOR IMPROVEMENT**

For the purpose of improving power Factor to 0.98 (approx) lagging and maintaining the same, suitably rated capacitor Banks will be provided at 6.6 kV switchboards. The capacitor banks will be complete with automatic power factor correction and switching devices which will facilitate for automatic selection and switching ON/OFF of the capacitor banks according to the load connected.

**4.4.12 ILLUMINATION SYSTEM**

The design of illumination system including fittings and installation will be aimed at providing proper level of illumination in both inside and outside of complex with safety and decorative features. Sodium Vapour Lamps shall be used for outdoor lighting whereas indoor lighting shall be done by sodium / fluorescent lamps/CF lamps according to the nature and requirement of the place.

The following levels of illuminations and type of fittings are envisaged. In case, the bidder offers any alternatives, the bidder shall bring out clearly in the bid with proper justification and reference, if any:-

<table>
<thead>
<tr>
<th>Name of the Place</th>
<th>Illumination Level (Lux)</th>
<th>Types of lights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receiving pit complex (Internal/ External) / around Silo / Crusher Shed etc.</td>
<td>70</td>
<td>HPSV</td>
</tr>
<tr>
<td>Conveyor gantries</td>
<td>70-100</td>
<td>HPSV</td>
</tr>
<tr>
<td>Conveyor drive and discharge house, transfer points, maintenance bay, etc.</td>
<td>150</td>
<td>HPSV</td>
</tr>
<tr>
<td>Substation, Control Room / MCC / Rear of control Panel / switch house/ Office</td>
<td>150-300</td>
<td>Fluorescent/ CFL</td>
</tr>
<tr>
<td>Control Desk</td>
<td>250-300</td>
<td>Fluorescent/ CFL</td>
</tr>
<tr>
<td>Area lighting (Lighting Mast)</td>
<td>50</td>
<td>HPSV</td>
</tr>
</tbody>
</table>

For illumination system, power shall be fed from 6.6kV/440 V, 3 phase lighting transformers located in 6.6kV switching station & in SILO control room... The distribution of power for illumination system shall be made through Lighting Distribution Board located at strategic places.
4.4.12.1 EMERGENCY ILLUMINATION

Two nos. DG sets of each 400 kVA capacity with automatic ON/OFF arrangement will be provided to facilitate power at strategic locations such as conveyors, control rooms, different floors of crushers, tunnels, receiving pit complex, ground Bunker, silo, staircases, transfer houses, canteen, etc at the time of power failure. For this separate wiring with separate luminaries shall be provided. The emergency light points shall be at a distance of not more than 50m. In addition, inverter emergency light shall be provided in all -stations & silo-loading complex.

4.4.13 EARTHING SYSTEM

The earthing system shall strictly conform to Indian Electricity Rules 1956 as amended up-to-date and IS-3043 current. Main earthing grid shall be provided around the periphery of switching station and Silo and along the conveyors for interconnection of grids of the buildings as well as to earth the electrical equipment on the conveyors like pull cord switches, belt sway switch, receptacles etc.

Each motor, transformer, 6.6 kV switchboard panel, 440V MCC, control and relay panels, lighting panels, receptacles, push button stations, junction boxes and other electrical equipment should be earthed by two separate earthing strips /GI wire of suitable sizes. In addition all the motors will be earthed through the armouring of the connecting cable. Size of earthing strip and electrodes shall be as per requirement of relevant IS. However, the size of main earth bus strip shall not be less than 65 mm x 5 mm whereas that of the connecting earthing strip shall not be less than 25 mm x 5 mm.

Conveyor structure, cable tray supports, cable trays etc. shall not be considered as earthing conductors. Metalic sheath, screens/shields and armour of all cables shall be earthed at both the ends at the equipment where the cables are terminated. Suitable earthing clips shall be provided as required.

Cable trays shall be earthed at every 10m intervals. Adequate care shall be taken towards earthing of light-fittings, welding sockets etc.

Separate earth pits for earthing of neutral of transformers and lightning arrestors shall be provided. All joints and connections of earth lead shall be welded/bolted securely.

The resistance to earth as measured shall not exceed 1 ohm. Test pits shall be provided at all interconnecting grid connections. Interconnection with employer's earth grid if any shall be made at least at two points by using test electrodes.

4.4.14 LIGHTNING PROTECTION

Lightning protection against direct stroke shall be provided for all structures, buildings, conveyor gantries, silo etc having a height of 10m or more. The lightning protection shall conform to IS 2309. Earthing system for lightning protection shall be independent of the earthing system for electrical equipment. It may be noted that the area designated for CHP including the neighbouring area of the mine is heavily lightning prone zone.

4.4.15 WELDING SOCKETS

For easy maintenance of entire plant centralised welding circuit shall be provided. In such system, there shall be provision for installation of welding machine (motor/generator set/welding transformer) for all area of complex including receiving pit complex, along conveyors and rapid loading system. For supply of power to welding machines, necessary circuit with plug and socket system of suitable capacity at an interval of not exceeding 50 m shall be laid by the bidder. This system shall facilitate connecting of welding lead at any point of plant for
welding/repair of steel structures. Independent centralized welding system for receiving pit complexes, Rapid Loading Complex shall be provided. Welding sockets shall be provided at convenient places such as each floor of receiving pit, Transfer/Drive houses, Substations, Gantries of Conveyor etc. Supply of adequate numbers of motor generator sets/ welding transformers as mentioned in Annexure-III.2 shall be in the scope of work of bidder

4.4.16 PLANT MONITORING AND CONTROL SYSTEM

In order to have better supervision, operation and control of the plant, microprocessor based programmable logic controller (PLC) suitable for industrial control system has been envisaged. The PLC shall have the facilities for remote monitoring and sequential control, including local operation of individual equipment, audio and visual fault annunciation, normal status display, signalling, data logging, data display and printing etc. with sufficient liability of management reporting.

The scope of work included in this bid consists of design, supply, erection and commissioning of micro-processor based plant complex monitoring and control system with suitable printing and display devices and associated software for providing real time remote monitoring and sequential control of the plant, including local operation of individual equipment for inspection/repair and maintenance. The system shall be provided with audio and visual fault annunciation, normal status display etc. All the three PLCs located in 6.6kV Switching station and Silo respectively shall be interfaced with the PLC located at 6.6kV switching station for Integrated Control system for the entire plant, from where it shall be possible to control the entire plant.

4.4.16.1 General system requirement

The system/equipment shall be capable of working satisfactorily to the guaranteed performance under dust laden atmospheric conditions having an ambient temperature of surrounding up to $46^\circ$ c and relative humidity up to 95%. The system design shall be such that in case of addition / modification of various equipment in the CHP, the system can be extended easily for monitoring and control of additional equipment. The software shall be such that by reconfiguration at site the system shall be able to accommodate the modification. Any equipment/sub-system specifically not covered shall deemed to be included to make system complete.

The system shall have the following facilities:

a) Real time automatic centralised control (starting and stopping) from control room for all equipment in accordance with a pre-determined sequence (both for starting and stopping) for normal operation of the plant so as to ensure safe and efficient operation of entire plant.

b) Stopping of any equipment from the control station located near the drive of respective equipment under all conditions including emergency

c) Stopping of conveyors in case of emergency by Pull Cord Switches, Belt Sway Switches, and zero speed switches, etc provided along the conveyors.

d) Starting and stopping of any desired equipment independently from local control stations located near the respective motors/drives for maintenance/repair/testing by selecting remote/local mode of operation from the control room through a suitable command.
e) Sounding audio alarm/warning system prior to starting of the plant for information to plant personnel/maintenance staff to keep a safe distance from equipment under operation.

f) Continuous status monitoring of all equipment e.g. conveyors, apron feeders, plough feeders, sump pumps, exhaust fans, tripper conveyors, main transformers, circuit breakers etc. In addition to status monitoring, monitoring of other parameters like overload, single phasing, earth leakage, belt sway, belt speed, lubrication system, bearing temperature, noise level, vibrations level of coal in bunker and silo, etc.

g) Colour visual display units with functional key boards to allow the operator in control room to observe status of operation of various equipment, alarms, fault annunciation mimic display on VDUs and to select the various displays on VDUs pertaining to inspection of state of readiness of control circuits prior to equipment to be started.

h) Dedicated keys on key board to select Remote/Local modes of operation and issue commands for starting/stopping drives in sequential/individual mode.

i) Management information reports.

j) Starting/stopping of Equipment which is not under sequence control from the site.

**4.4.16.2 Detailed system requirement**

For the purpose of convenience of operation, the Silo loading arrangement near Maheshpur siding with CHP is divided into following zones:

a) **Zone A**: Comprises all electrical drives of both the receiving pit complex i.e. Crusher, coal sizer, plough Feeders, rock breaker fire fighting system, Conveyors BC1, BC3, BC4, MagneticSeparator, MetalDetector, apronfeeders, grab attachment, dust suppressor etc.

b) **Zone B**: Comprises of all electrical drives i.e. Tripper Conveyors, sump pump, dust extraction/suppression and fire fighting system, Conveyors BC2, belt weigher etc.

All the equipment in Zone A & B will be controlled from a control desk located at control room –I (CCR-I) on the first floor of 6.6kV switching station.

c) **Zone C**: Equipment of Rapid loading system complex

All the equipment in Zone C will be controlled from a control desk located in control room in the silo complex.

The control systems envisaged in Zone A & B will only be restricted for operation of equipment locally for testing and maintenance purpose. The sequence operation of the entire plant starting from crushers up-to level indicators installed in silo shall be done from a central control console located in control room at 6.6kV switching station. The status of individual equipment of Zone C shall also be available at this central control console.
However the status of individual equipment of that particular zone along-with fault annunciation system shall also be made available in the control room of respective zones.

The central control console shall be dedicated for monitoring and control of zone –A, B and sequence control of silo level indicator with plough feeders, sequence interlocking of conveyors and ultimately with both the crushers at the receiving pits. This console will also be responsible for generation of reports for MIS purpose.

**Sequence operation of the equipment**

All the equipment in a flow will be started from the central control room II in a sequence with consecutive equipment to start one by one with a definite time lag. The sequence starting of drives will be in the reverse direction to the flow of coal as shown in Drawing. RI-2 / E&M / 300023. Similarly, while stopping the drives of a particular flow the drives shall be stopped one by one in a sequence with a definite time lag so that the equipment or conveyors are unloaded before they stop. The stopping of drives will, however, be in the direction of flow of coal. The Control Desk cum mimic panel at Central Control Room – I shall have operator console with functional key-board with VDU for mimic display and annunciation. Apart from this, Central Control Room –I shall have VDU with facilities for composite mimic display. The communication equipment shall also be housed in this control Room. From a functional Key-board of the control room, all the related equipment shall be remotely started or stopped in sequential manner and the coal flow of all equipment shall be displayed in the respective mimic display. The respective annunciation shall indicate the status of different equipment and conveyor health monitoring parameters. Similarly Control Desk cum mimic panel at control room of Rapid loading complex shall have operator console with functional key-board with VDU for mimic display and annunciation.

**Remote & Sequence Control**

Following operations have been envisaged for remote and sequence control

a) **Inspection** :
   In case of sequence operation an inspection facility shall be provided in the circuit to check before actual starting that all the technological mechanisms are interlocked at the starting moment. This can be ascertained by key-board function which affects the pilot display in the circuit (to be displayed in VDU).

a) **Signalling** :

   The strategic points of the plant shall be equipped with two way Audio-visual signalling. This will ensure rapid and reliable communication between the strategic points and the operator in the control room for safe working as well as during emergency. Signal lamps and alarm bells for the operation of signal circuit are to be installed at the control room at the following strategic points.

   c) **Ready** : The plant shall be ready to start by a another key-board function with luminous head starts blinking indicating that the system is ready for starting

   d) **Alarm** : When blinking of luminous head becomes steady, the operation of alarm system starts. The hooters connected with the Alarm system shall be suitably located in the plant to provide adequate warning to the persons at site.

   The hooters keep on blinking until the whole plant comes into operation. The hooters in the alarm circuit shall be situated at the following points and shall be controlled form the control rooms as follows :
From Central Control Room – for Control Zone – A & B
Gantry of Conveyors C1, Crusher Room of Receiving Pit complex, Gaantry of conveyor C 2, Tripper conveyors C3 & C4 located at tunnel below ground bunker

From Central Control Room – for Control Zone – C
Silo complex

d) Start:
After actual time of starting the hooters, the start function commences blinking for the specified time. The operator shall operate the start function within the specific time, so that the plant may start, otherwise the cycle will have to be repeated. Gradually, all the indications of individual drives start glowing on the mimic one by one showing that the plant is running.

e) Stop

Normal stop
Under normal conditions of sequence control the stopping of the plant is affected from the control desk at control Room – II by another key board function. The stopping shall be made in sequence with a definite time lag in the direction of coal flow.

Emergency Stop: Emergency stoppage may be caused by:

i) The depression of emergency stop key on the key-board in the respective control desk in the central control room – II.

ii) The depression of emergency push button from any of local control stations at site

iii) The depression of pull cord switch
Any emergency cut out of any of the drives in a flow causes an immediate switching off all the drives in the flow line.

In the event of emergency stoppage a siren starts giving warning distress sound to attract the attention of personnel working in the plant. The siren keeps on blowing till acknowledged from respective control room.

f) Automatic stop of flow on fault
In the event of stoppage of an equipment in sequence due to electrical fault such as over load, single phasing and mechanical fault such as tearing of conveyor belt and operation of belt sway detective device etc, the preceding equipment in the stream will stop immediately while the succeeding equipment will stop like normal stopping in sequence with present time lag.

h) Local Control
The local control system shall have the facility of remote operation and interlocking of a particular flow from the respective control desk and control room of rapid loading complex so that an individual equipment in a flow can be operated from the site by means of Local Control Station (LCS) installed
near the respective equipment. This provision shall facilitate inspection, maintenance and test run of the equipment whenever required.

A key board function for each flow shall be provided on respective keyboards with suitable locking arrangement for transfer of operation in local mode. Similarly, in each LCS a two position remote-local rotary switch (lockable in both positions) shall be provided. This selector switch on each LCS shall be interlocked with the key – board function in such a way that –

a) Unless all the selector switches of LCS in a particular flow line and selector switch on particular CCD are not on ‘Remote’ mode, the remote and sequence operations from control room is not possible and

b) Unless the selector switch of the particular equipment in a flow is not in local mode and local operation function is not effected from control room, the local operation of individual equipment from site is not possible.

A yellow indicating lamp shall be there with each LCS which shall glow when the local operation function is effected from respective control room.

4.4.16.3 Facilities required for Zone – A

a) The operator console for zone A located in the Central control room shall have the following facilities:
   - Inspection
   - Pilot display
   - Signalling with alarm
   - Ready
   - Start operation for Local starting of electrical equipment of this zone.
   - Emergency stop key
   - Stop operation
   - Transfer to local mode
   The operator console shall have facility for extension.

b) The mimic display shall have the following:
   - Complete graphic representation of all equipment in that zone.
   - Three colour indication with diagram of each equipment (Green, Red, Yellow) for OFF, ON and LOCAL
   - Indication for status display of all the equipment of this zone
   - Visual indication for showing status of conveyors of this zone.

c) The fault annunciation shall have the following facilities:
   - Belt Sway Switch operated.
   - Pull chord Switch operated.
   - Zero Speed switch operated.
   - Motor protection Device operated due to Overload, Single phasing,
     Earth Fault, Earth leakage
   - Local Emergency Stop P.B. operated.
   - 6.6 KV Motor winding Temperature High.
   - 6.6KV Motor Bearing Temperature High
   - 6.6KV Circuit Breaker Tripped.
   - 440 Volt ACB Tripped.
   - 6.6 KV fuse fault.
   - Earth Leakage Relay operated.
   - Transformer Buchholz relay operated
   - Transformer winding Temp. High
   - Transformer Oil Temp. High
   - Any other item as found necessary during detailed engineering stage by the customer/consultant
d) Individual Annunciation for following features shall also be provided.
- Metal detected
- Emergency stop P.B. of Control Desk operated
- A.C. control supply failure
- D.C. control supply failure
- Primary & Secondary crusher hydraulic pressure high
- Primary & Secondary lub. System fault
- Primary & Secondary lub. Oil Tank level low
- Primary & Secondary control temperature high
- Primary & Secondary system fault
- Primary & Secondary tripped
- Primary & Secondary box level high

The Annunciation facility for crushing system will be arranged in separate block.

The conveyors and equipment should be able to trip on occurrence of any of the following fault/conditions:

i) Under speed fault (for conveyor only)
ii) Belt sway fault with the arrangement to by pass belt sway switches at the time of the starting of the plant and also during normal running if found necessary. (for conveyors only)
iii) Pull chord switch fault (for conveyors only)
iv) Single phasing of the power supply
v) Motor winding and bearing overheating for HT & high capacity LT motors.
vi) Bearing temperature of mechanical equipment like gearbox, HT drives, etc.
vii) Motor overload.
viii) Any other fault if found necessary during detailed engineering stage by the employer.
ix) Bearing and winding temperature high of HT motors of critical equipment like crusher, apron feeder, belt conveyor and fire fighting pumps.

e) The local Control Station shall have the following facilities:
- Start – Stop push button
- Selector switch (Remote – Local)
- Emergency stop switch
- Indication lamp (Yellow)

There shall be suitable nos. of LCS’s in each zone

f) Provision of potential free NO & NC contacts and other required accessories for interlocking and composite Mimic Display at Central control Room –II for equipment of this zone

g) Status indication for dust suppression/dust extraction and ventilation system
There shall be positive ON-OFF indication for Dust suppression, Dust Extraction and ventilation system in the VDU.
4.4.16.4 Facilities required for Zone – B

g) The operator console for zone B located in the Central control room shall have the following facilities:
   - Inspection
   - Pilot display
   - Signalling with alarm
   - Ready
   - Start operation for Remote and Local starting of electrical equipment of this zone and also for the entire plant.
   - Emergency stop key
   - Stop operation
   - Transfer to local mode

The operator console shall have facility for extension.

h) The mimic display shall have the following:
   - Complete graphic representation of all equipment.
   - Three colour indication with diagram of each equipment (Green, Red, Yellow) for OFF, ON and LOCAL
   - Indication for status display of all the equipment of this zone
   - Visual indication for showing status of conveyors.

i) The fault annunciation shall have the following facilities:
   - Belt Sway Switch operated.
   - Pull chord Switch operated.
   - Zero Speed switch operated.
   - Motor protection Device operated due to Overload, Single phasing, Earth Fault, Earth leakage
   - Local Emergency Stop P.B. operated.
   - 440V Motor winding Temperature High.
   - 440V Motor Bearing Temperature High
   - 6.6KV Circuit Breaker Tripped.
   - 440 Volt ACB Tripped.
   - 6.6/0.440 KV fuse fault.
   - Earth Leakage Relay operated.
   - Transformer Buchholz relay operated
   - Transformer winding Temp. High
   - Transformer Oil Temp. High
   - Any other item as found necessary during detailed engineering stage by the customer/consultant

j) Individual Annunciation for following features shall also be provided.
   - Metal detected
   - Emergency stop P.B. of Control Desk operated
   - A.C. control supply failure
   - D.C. control supply failure
   - Primary & Secondary crusher hydraulic pressure high
   - Primary & Secondary lub. System fault
   - Primary & Secondary lub. Oil Tank level low
   - Primary & Secondary control temperature high
   - Primary & Secondary system fault
   - Primary & Secondary tripped
   - Primary & Secondary box level high
The Annunciation facility for crushing system will be arranged in separate block.

The conveyors and equipment should be able to trip on occurrence of any of the following fault/conditions:

x) Under speed fault (for conveyor only)

xi) Belt sway fault with the arrangement to by pass belt sway switches at the time of the starting of the plant and also during normal running if found necessary. (for conveyors only)

xii) Pull chord switch fault (for conveyors only)

xiii) Single phasing of the power supply

xiv) Motor winding and bearing overheating for HT & high capacity LT motors.

xv) Bearing temperature of mechanical equipment like gearbox, HT drives, etc.

xvi) Motor overload.

xvii) Any other fault if found necessary during detailed engineering stage by the employer.

xviii) Bearing and winding temperature high of HT motors of critical equipment like crusher, apron feeder, belt conveyor and fire fighting pumps.

k) The local Control Station shall have the following facilities:

- Start – Stop push button
- Selector switch (Remote – Local)
- Emergency stop switch
- Indication lamp (Yellow)

There shall be suitable nos. of LCS’s in each zone

l) Provision of potential free NO & NC contacts and other required accessories for interlocking and mimic display at Silo Room for equipment of this zone

g) Status indication for dust suppression/dust extraction and ventilation system

There shall be positive ON-OFF indication for Dust suppression, Dust Extraction and ventilation system in the VDU.

4.4.16.5 Facilities required for Zone – C

4.4.16.5.1 Automatic Sequential Control, Signalling and Interlock of the Equipment

All the electro–mechanical equipment at the silo loading complex shall be controlled by microprocessor based PLC incorporating standard programme, software packages etc for their operation. Auto sequence operation for all the equipment for loading of coal from silo to wagons shall be provided. However, in case of failure of sequence control, manual operation shall be affected from the control desk.
The equipment of coal in-feed circuit to the silo shall be controlled (start/stop) from a Central Control Console (CCC) suitably located in the control room of the silo. The sequence start/stop switch shall also have local /site position to facilitate starting/stopping of each equipment from the site for maintenance.

The coal in-feed circuit consists of two reclaim conveyors C3 & C4 and four plough feeders below the ground bunker. The CCC shall also have the continuously illuminated mimic panel with graphic symbol of each equipment being controlled to show the status (running/not running) of the equipment. In addition to above, this mimic panel shall also have the status indication of tripper conveyors over the ground bunker and indication of the status of levels in the ground bunker.

The level of coal inside the silo at any instant shall be monitored by a continuous monitoring device. The system shall stop plough feeders as soon as the level of coal reaches high level point and stop loading as soon as it reaches low level point. The temperature of coal in the silo at different levels shall be continuously monitored and it will give audio-visual signal as soon as it reaches the pre-set value.

The level indication and temperature sensing devices shall be located outside silo pre-weigh bin hopper with suitable enclosure for maintenance.

Stage monitoring in PLC shall be provided for hydraulic system, loading system, weighing system etc for easy location of fault.

The PLC shall have suitable print out facility to provide print out data of wagon incorporating date, time, tare and gross weight of wagon, daily, monthly and annual record of despatches.

The other facility required for this zone shall be as under:

a) The operator console shall have with the following facilities:
   - Inspection
   - Pilot display
   - Signalling with alarm
   - Ready
   - Start operation for Remote and Local starting of electro-mechanical equipment.
   - Emergency stop key
   - Stop operation
   - Transfer to local mode
   The operator console shall have facilities for extension

b) The mimic display shall have the following:
   i) Complete graphic representation of all equipment. iii) Three colour indication with diagram of each equipment (Green, Red, Yellow) for OFF, ON and LOCAL
   ii) Indication for status display of all the equipment.
   iii) Visual indication for showing status of Conveyors.
c) The fault annunciation shall have the following facilities:

- Belt Sway Switch operated.
- Pull chord Switch operated.
- Zero Speed switch operated.
- Motor protection device operated due to Overload, Single phasing, Earth Fault, Earth leakage
- Local Emergency Stop P.B. operated.
- 6.6 KV Circuit Breaker Tripped.
- 440 Volt ACB Tripped.
- 6.6 KV fuse fault.
- Earth Leakage Relay operated.
- Transformer Buchholz relay operated
- Transformer winding Temp. High
- Transformer Oil Temp. High

Any other item as found necessary during detailed engineering stage by the customer/consultant.

d) Individual Annunciation for following features will also be provided:

- Emergency stop P.B. of Control Desk operated
- A.C. control supply failure
- D.C. control supply failure
- Continuous bin level device annunciation for silo full, half and minimum level
- Fault in hydraulic system of gate opening
- Formation of arch in silo
- Fire control alarm on annunciation
- Any other annunciation considered necessary for loading operation

The conveyors and equipment should be able to trip on occurrence of any of the following fault /conditions:

i) Under speed fault (for conveyor only)
ii) Belt sway fault with the arrangement to by pass belt sway switches at the time of the starting of the plant and also during normal running if found necessary. (for conveyors only).
iii) Pull chord switch fault (for conveyors only)
iv) Single phasing of the power supply
v) Motor overload.
vi) Any other fault if found necessary during detailed engineering stage by the employer.

vii) The local Control Station for this Zone shall have the following facilities:

a. Start – Stop push button
b. Selector switch (Remote – Local)
c) Emergency stop switch
d) Indication lamp (Yellow)
There shall be suitable nos. of LCS’s in this zone

4.4.16.5.2 FLOOD LOADING OF UNIT TRAIN WAGONS

For operation of wagon loading chute gate and silo guillotine type gates of the pre weigh hopper, loading control console (LCC) shall be provided at suitable location so that the wagon loading operation can be viewed simultaneously while loading operations is in progress.

Loading of Unit train rakes shall be done from the flood loading chute along with its associated gates system. To warn the merry go round engine driver and concerned loading operator for loading of the unit train necessary visual indication shall also be provided for the flood loading chute (at suitable locations) and on the loading control console and LCC. The flood loading swing chute will be also interlocked with flood loading gate for its logical operation.

4.4.16.5.3 CONTROL SYSTEM FOR FLOOD LOADING OF UNIT TRAIN WAGONS

Control system for flood loading system will be micro processor based. This will include weigh sensing elements with associated power supply/amplifier, loading control console (LCC) cathode ray tube(CRT) display with key board and a printer. The CRT shall be used to enter set point for weigh hoppers, wagon identification numbers and tare weight of each car of unit train for visual check for correct feed into the micro-processor system. In addition, it shall give the operator a visual indication of what is happening during loading operation.

Each of the four load cells supporting the weigh hopper shall include precision strain gauge load cells supplied in compression. The dual bridge load cell shall be capable to retain electrical integrity to 150% of rated capacity.

It shall also be structurally safe to 300% of rated capacity.

The load cell excitation and amplification of output signals shall be done by a precision power supply/amplifier, filter/isolator, voltage to frequency converter, automatic zero circuit and test circuits and the frequency output shall be fed to the weight display console/printer. The care shall be taken in proper grounding, shielding and guarding technique to eliminate errors which might be introduced by thermal effect, stray pick up etc.

4.4.16.5.4 OPERATION OF SILO OUTLET GATES AND FLOOD LOADING CHUTE AND GATE

The four silo outlet gates to pre weigh hopper shall be hydraulically operated and cylinders shall be provided with positioners to provide a reduced feed rate at near balance conditions to achieve a precise cut off at the desired weight. For this purpose normally all four silo gates will be opened to fill the weigh hopper initially. As the hopper approaches 60 Te mark, two gates will be closed completely and balance two will be closed to the 60% position. For final trimming one or both adjustable gates may be used. The flood loading gates shall also be hydraulically operated. The gate area shall be adequate to ensure clearing of the weigh hopper in calculated time on each cycle. The flood loading swing type chute shall be hydraulically powered to move vertically upward or downward directions.

However, operation of the chutes shall be electrically controlled from the loading control console (LCC) located in the control room. The wagon loading flood chute
selector switch will have 3 positions for positioning the chute over wagons of different heights as well as controlling height of coal loaded in the wagons.

4.4.16.5.5 WAGON POSITIONER AND AUTO LOADING OF WAGONS

Below loading chute gate around the track there will be suitable wagon positioners to indicate that the first wagon of unit train has reached on the proper location after discriminating the engine and the indication to this effect shall be provided on loading control console (LCC). The flood loading chute data shall be interlocked with this device in such a manner that the loading gate shall not in any case open when the wagon and retractable flood loading chute is not on the proper operating positions. However, while providing this device, care must be taken that it should not actuate any signal for opening of the flood loading chute gate when the engine passes through this point. Besides automatic loading of the wagons there shall be provision of manual loading also from the loading control console (LCC) and necessary controls to this effect shall also be provided in the control console. For this purpose selector switch with “AUTO-MANUAL-EMERGENCY MANUAL” shall be provided in the control console.

4.4.16.5.6 INTERLOCK

All equipment shall be electrically/mechanically interlocked to ensure starting and stopping of their drives in a sequence or as required for logical operation of the system and adequate time lag will be provided to avoid overloading of the electric/hydraulic system.

The four gates feeding pre weigh hopper below silo shall be interlocked with corresponding flood loading chute gate with suitable time lag. As soon as the weight of coal in weigh hopper reaches a pre determined set point as mentioned elsewhere the gate should automatically close as described earlier and it should open up only when the weigh hopper has been emptied and the flood loading chute and gate is also closed. The interlock of the equipment shall be in-conformity with the mechanical system as elaborated elsewhere in this tender.

4.4.16.5.7 LOADING CONTROL CONSOLE (LCC) FOR FLOOD LOADING OF UNIT TRAIN WAGONS

The control console (LCC) with CRT display and Dot Matrix printer shall be designed to mount in front of the control room windows so that the operator can have full view of the loading operation. These shall have all pertinent control devices and visual indicators.

The console shall generally house the following switches/push buttons :-

ii) Close-hold –open control switch for silo outlet gates.
iii) Flood loading chute- loading and retracted position control switch.
iv) Flood loading chute Raise-Hold Low position control switch
v) Open-Hold-Closed control switch for flood loading gate for Manual operation.
vi) Automatic feed cut-off control with weigh hopper weight set point adjustment selector switch.
vii) Weigh cycle start push button.

viii) Weigh cycle stop push button.

ix) Test weight Raise-Hold-Lower position selector switch.

x) Control power ON/OFF switch

Hydraulic power start push button

xii) Hydraulic power stop push button

xiii) Alarm push button

xiv) Skip next wagon push button

In addition to the above mentioned switches/push buttons the control console shall also house visual indicators/lamps to show the following:

- Silo outlet gates 100% open, 75% open, 50%, 25% open and closed for two gates for precision feed cut-off
- Silo outlet gates open and closed for the other pair of gates.
- Control supply on.
- High-Intermediate-Low level of coal in the silo.
- Weight of coal in weigh hopper has reached the pre-set value.
- Flood loading gates open and closed.
- Flood loading chutes in loading position.
- Flood loading chutes in retracted position.
- Flood loading chutes in extended position.
- Test weights on.
- Unit train in.
- Wagon in position
- Panel clock with date.
- Net weight of coal loaded in metric tonnes.

Battery powered back up shall be provided for the system to enable the microprocessor etc. to operate even during the power failure.

4 4 17 TRAFFIC CONTROL CONSOLE & LOCAL CONTROL CONSOLES

In addition to control console for controlling the equipment the following control consoles shall also be provided.

4 4 17 1 TRAFFIC CONTROL CONSOLES (TCC)

Microprocessor based Traffic Control Console (TCC) along with photo sensing device shall be provided in Traffic Control Operator’s room (TCO) for controlling the movement of dumpers to guide the dumpers to the empty bay of the receiving pit. Empty/full status of bay shall be displayed on the master signal post (MSP) located at the dumper entry point.

The Master Signal Post (MSP) shall be located at the traffic entry point, and its display shall be automatically controlled. There shall be provision so that automatic signalling may be over ridden by manual operation initiated by the traffic control operator (TCO) from his room. The incoming traffic of dumpers shall be clearly visible from TCO’s room. Display of MSP shall be repeated in TCO’s control console in traffic control room. In addition to above display control console shall have mimic diagram displaying inter-alia the following:

a) The status of the crusher ON/OFF
b) Status of the bay (engaged / free)
c) Permissive signal from local control cubicles (PERMIT/STOP)
4.4.17.2 LOCAL CONTROL CONSOLE:
There shall be a local control console (LCC) for crusher located above the receiving pit. LCC shall locally guide the dumper operations with signals which will be part duplication of the traffic control console signals (entry permissive lamps as envisaged for MSP shall be repeated here to take care about the manual intervention signal by the TCO). In addition it shall have the following facilities:

i) “Emergency Stop Push Button” for the crusher.

ii) Indication lamps for crusher running / not running.

iii) Hooters

The location of the LCC shall be such that the LCC operator can supervise the dumping operation from this console. LCC shall also have photo-sensing device to monitor the dumpers.

4.4.17.3 DIGITAL DISPLAY COUNTER
This will be located on the Mimic panel in the central control room of switching station. This will display the date, time, the number of dumpers received in the receiving pit and total running of all the apron feeders.

4.4.18 SITE CONTROL STATION
For the purpose of control for maintenance, repair and testing, near every motor / drive, a site control station / switch shall be provided. This site control station shall be in dust proof enclosure. The site control station forming part of the control system shall comprise the following:

Three position change over switch “Desk-Off-Site” positions, corresponding to the operation of the equipment from the desk or site.

Start stop push buttons for site control equipment.

The selector switch shall be provided with detachable handle or shall have facilities for locking in the site position.

The push button shall be shrouded to prevent accidental and un-intentional operation.

The stop push button shall have lockout features.

The start push button shall be “GREEN’ in colour and stop push button “RED”.

4.4.19 PRESSURISATION AND AIR CONDITIONING
Panel room of substations shall be pressurised with conditioning of inlet air and control of humidity for proper operation of equipment and comfortable working of personnel inside the room. The number of air changes shall not be less than 15 per hour. Window type air conditioners of 1.5 Te capacity should be provided at engineer-in-charge’s rooms, maintenance cum testing rooms, Control rooms, PLC rooms, Dy. CE (E&M)’s office. The design and construction of all rooms of sub-stations shall be such that it shall be possible to prevent entry of dust and at the same time maintaining the proper temperature inside for proper working of the equipment and the personnel. Sufficient numbers of ceiling fan and exhaust fan shall be provided wherever required.

4.4.20 COMPUTER FOR THE OFFICE OF ENGINEER IN-CHARGE
1 No. PC, type, Pentium-IV with Laser printers shall be provided for the office of Officer/Engineer In-charge, in addition a laptop shall be provided as mentioned elsewhere.

Desktop PCs should be complete with UPS of 30 minute back up.
4.4.21 MAINTENANCE AND SAFETY

Suitable provision for maintenance of equipment and safety shall be made. General requirement for maintenance and safety is given in section IV.1, sp/M-13

4.4.22 APPROVED VENDORS

Plant and Equipment supplied within the country shall be from approved vendors as listed in "Approved Vendor List" in Appendix-D. In case the bidder intends to supply P&M from vendors not listed in approved vendor list, written approval of the employer shall be taken who, after evaluating of eligibility and qualification of such vendors, may choose to include them in approved vendor list. Bidder in his bid shall furnish information for evaluation and qualification of each such vendor in the tender and also may submit same in pre-bid meeting. The criteria and formats for evaluation of vendors are given in appendix-E.

For plant and equipment supplied from vendors abroad, information for evaluation and qualification of each vendor shall be furnished in the bid and the written approval of employer for approved foreign vendors shall be taken.

No further request for inclusion of vendors after finalisation of tender shall be entertained.

4.5 CIVIL AND STRUCTURAL WORKS

4.5.1 GENERAL

The scope of work under this contract shall include design, construction and successfully commissioning of all civil and structural works, supply of detailed survey drawing showing contour, geo-technical investigation including the supply of geo-technical report, supply of detailed design, working drawings including all relevant calculations and all necessary works as may be needed for testing and commissioning, elimination of all teething trouble, performance test and handing over of the plant as envisaged in detailed scope of work and system description. The necessary construction, erection, commissioning equipment related to civil engineering works shall be provided and transported to the site of work by the contractor. Due consideration shall be given for economy, architecture and functional utilities. This is a contract for purchase of complete installation including planning and design, manufacture, execution, supply, erection of civil & structural work. Accordingly, all works needed for successful completion and operation of the plant shall be covered in the Scope of work whether specifically mentioned here or not.

Adherence to Indian Standards

All the works including designs, drawings, construction, fabrication, testing, erection, etc. shall be done strictly as per relevant BIS Code of Practices. Wherever no Indian Standard is available, British, American, German, Soviet or other international standards may be used only as per its applicability and justification.

4.5.2 Basic scope The scope of work covers all the related civil and structural works, detail designing of the same and successfully commissioning of the civil and structural works for handing over the plant. This shall inter alia, include the following

4.5.2.1 Design & engineering of all civil and structural works of the plant.

4.5.2.2 Execution of all civil/structural works consisting of the following:

a) Detailed survey of site including contour map preparation.

b) All the geo-technical investigation required for the work including furnishing the geo-technical report, Collection of hydrological, blasting and rainfall data including any other data related to design and execution.

c) Preparation of construction site.

d) Supply of fabricated structural steelwork and shaped rebars as required.

e) Supply of all civil construction materials and other materials required.

f) Execution of all civil works.

g) Fabrication/erection of structural.

h) All civil and structural works of connected equipment and accessories under supply.

i) Excavation/ construction/ erection/ installation and commissioning of all auxiliary services such as sanitary, drainage, roads, retaining walls, pavements, office and service buildings, lighting towers, landscaping/ grading/ levelling/fencing/site clearing as detailed elsewhere.

j) Transportation of all construction materials to site, whether procured within the country or from other countries.

k) Water supply arrangement for potable, industrial and fire fighting purposes.

l) Drainage and sewage treatment (for domestic and industrial sewage) including its dovetailing with the existing system.

m) Fire fighting arrangement.

n) Roads, pavements, retaining walls, culverts, etc.

o) All the protective measures for proper drainage for safety of structures, against ingress of water / seepage due to seasonal nallahs and its tributaries which are flowing through the construction site area as per actual site conditions and requirement.

p) All the protective measures for safety of men and materials during construction against rail/dumper movements on existing railway tracks/haul roads.

q) Construction of approach road upto receiving pits shown in the key plan.
4.5.2.3 Inspection and testing.

4.5.2.4 Perception and remedial measures for the safety of entire CHP area under the scope keeping in view the adjoining natural and artificial features such as hill slopes, nallah, buildings, etc.

4.5.2.5 Any other works/services not mentioned but required for the completion and commissioning of the plant.

4.5.3 DESIGN/ENGINEERING

4.5.3.1 Design Criteria

All detailed design and working drawings will be developed with proper co-ordination and inter-relation with mechanical and electrical equipment. The design of RCC structure shall be carried out in general as per code of practice of plain and reinforced concrete for general buildings construction BIS 456-2000 and other relevant standards including up-to-date amendments. The steel structure shall be designed and fabricated as per Code of practice for use of structural steel in general building construction BIS 800 (latest edition) with up to date amendments and other relevant IS standards. The building/structure shall conform to local by-laws, rules and regulations for industrial buildings and as per relevant Indian Standards. Latest codes of practice with amendments up to date shall be strictly followed. In the absence of BIS codes, British standards Institution or the approved international bodies codes could be considered for design as per its applicability and justification.

The bidder shall be responsible for and shall pay for any alterations of the work due to any discrepancies, errors or omissions in the design and drawings or other particulars supplied by him, whether such design, drawings or other particulars have been approved by customer or not.

4.5.3.2 Load consideration

Loads to be considered in design shall be as per relevant BIS codes of practices. Generally, in design the effect of dead loads, live loads, load due to impact, vibration, erection, wind load, seismic loads, dust load and load due to surcharge and moving vehicles, effect of blasting etc. wherever applicable shall be considered. The loads due to equipment shall be supplied by the bidders. In general, live load, wind loads, etc shall be as per BIS-875 (latest edition). Seismic loads to be considered in design shall be as per BIS 1893 (latest edition). The maximum bulk density of coal will be taken as 1.15Te/m3 for load design calculation in respect of coal retaining structures. However, this is to be verified through lab test and reports to be submitted by the bidder before approval of drawings. Effect due to blasting is to be considered while designing the structures, as per the provision of BIS:6922 with latest revision:

The topography factor for the calculation of design wind pressure shall be calculated as per BIS 875 read with the latest amendment.

4.5.3.3 Analysis & Design

All RCC and steel structure shall be designed in accordance with relevant IS Codes of practice of latest revision. In the analysis of structures, the worst loading combination of belt pulls, equipment loads, their impact, wind/seismic loads/blasting effect, coal and other loads as envisaged shall be considered.
4.5.3.4 Design drawing & detailed engineering

Broadly all the dimensions as given in NIT drawings are to be followed for bidding purpose. These dimensions are indicative & may require changes during detail design.

4.5.3.5 Preparation

All the drawings shall be prepared in accordance with the provision of latest Indian Standards. All drawings shall be sufficiently detailed and dimensioned to help in speedy construction, fabrication and erection of structures. Wherever, any structure is presented in more than one sheet of drawings, same scale and notations shall be used in all the sheets for linking the drawings with each other. All modifications made in structure during various stages of construction should be duly incorporated in working drawings.

Bar bending schedule, detailed material list and specification of works shall be prepared / detailed. Working drawing shall also include general arrangement drawings showing plans at different levels with sectional elevations. Separate detailed drawing shall be prepared for inserts and anchor bolts including their fixing details. The design drawings associated with steel structure should show the force in the members, complete details of all members, joints, gusset plates, welding, riveting, bolting, etc. The drawings should also show the weight of each assembly/sub-assembly as far as possible. In addition to design drawings, fabrication drawings shall also to be prepared, showing item-wise details, erection units, materials list, details of fasteners with assembly, etc.

4.5.3.6 Submission of Design/Drawings

The contractor shall submit Geo-technical report, all the relevant detail design calculations, general arrangement/detail drawings, bar bending schedule, detailed material lists, specification of works including contour plan for approval of owner / consultant on standard size sheet.

Scrutiny and approval of drawings may be carried out through the consultant engaged by owner. All design details and drawings shall be submitted for approval of the following:

- General Arrangement Drawings
- Detail design calculations
- All detail civil/structural/fabrication drawings
- Any other drawings relevant for execution/fabrication of civil/structural works

Contractor shall submit for approval six sets of drawings along with detailed design calculations including analysis of force/stress in the structure along with the source from where data, except BIS codes, have been taken. Photocopies of such data should be submitted along with the design.

4.5.3.7 Procedure of Approval of drawings

The Owner shall have the final say in the approval of drawings. Drawings so submitted will become the property of the Owner. The approval of the drawings does not absolve the Contractor from the overall responsibility of the plant for its successful operation. The Contractor shall be responsible for and shall pay for any alterations of the work due to any discrepancy, errors or omissions in the
drawings or particulars supplied by him, whether Owner has approved such drawings or other particulars.

Approval by Owner / Consultant

Design & drawing, submitted by the contractor, shall be scrutinised by owner. Out of six sets of drawing submitted to the owner, one copy will be sent to contractor after scrutiny comments, modification or approval as the case may be. The contractor shall carry out the necessary rectification in drawings after discussion with owner in a reasonable time as agreed upon mutually and re-submit six copies of such revised drawings for approval of owner. Revised drawings shall then be scrutinised and approved if the comments made by the Owner are incorporated / taken care of. One copy of such drawing will be sent to the Contractor after approval.

4.5.3.8 As built drawings

Contractor shall make necessary correction / modification in the drawing as per actual work and shall prepare as built drawing. The Contractor shall supply such 8 (eight) sets of prints of as built drawing to the Owner along with one set of reproducible drawings on polyester paper in ink. The same will hold good for other documents also to be supplied by the Contractor under the heading of basic scope. All drawings should be prepared on AutoCAD in standard format and CD containing such drawing shall also be supplied along with hard prints.

4.5.4 Technical specifications

The enclosed technical specifications are only for guideline of the bidders and are not exhaustive. As such bidder should plan the work and items in detail and if in bidders opinion some items/work are not covered in the specifications, they should include the same in their tender.

Requirements for the performance of Civil and Structural Works are given below. For General Specifications for materials and workmanship see SP/C1 to SP/C24.

However, all the civil and structural works shall be as per latest BIS codes/ IRC codes/ MORTH codes and CPWD specifications.

4.5.5 DETAILED SCOPE

4.5.5.1 General

The civil and structural work under, its scope shall cover all aspects of work, including soil and hydrological investigation, collection of rainfall data, detailed survey, preparation of preliminary drawings with proper co-ordination and inter relation with equipment, detailed design and preparation of the complete civil and structural working drawings, execution and erection of the complete civil and structural works, including roads and pavements, sanitation, water supply for industrial, drinking and fire fighting purpose besides water supply to various buildings and structure for dust suppression and extraction and cleaning as per system requirement and land development.

The execution of civil and structural work consist of providing all labour, supervision, materials, scaffolding, construction equipment, tools and plants, supply, transportation, and all incidental items not specified but implied for successful completion of the works in accordance with drawing and specification including any fee, tax, royalty as may be applicable in the work zone.
The nature of work shall generally involve chemical testing of construction water for corrosive action of chemical and other deleterious materials, earth work in filling and excavation in all types of soil and rock, dewatering, shoring, back filling around completed structures, disposal and form work, brick work fabrication and erection of structural/miscellaneous steel, inserts, anchor bolts, RCC/chequered plates trench covers, laying of water pipe lines, sewerage system, roads, surface and storm water drainage, ventilation related to the coal handling plant, damp proofing and other ancillary items. The drawings as mentioned elsewhere in this contract documents give a general idea about the work to be performed.

These are preliminary drawings for bidding purpose only and are by no means the final drawings showing the full range of the work under the scope. Work has to be executed according to approved working drawings, fabrications drawings with additions, alterations and modification made from time to time as required or approved by the customer.

4.5.5.2 MAIN COMPONENTS OF CHP

The civil and structural works are related mainly to the following areas (but not limited to):

4.5.5.2.1 Receiving pits complex  (As per system drawing no. RI–2/E&M/…. 200029

Two nos of receiving pit complex each having with all provision of civil and structural work for accommodating one no single roll crusher & one no coal sizer and installation of the crusher along with associated equipment in this complex as per system drawing. WBM pavement will be so designed around the complex so that it shall be provided to facilitate the movement of loaded tippers of capacity 25t. The WBM pavement shall be designed to withstand the movement of loaded tippers. The pavement layout and design shall be done by the bidder considering protection and safety of structures and free movement of tippers.

4.5.5.2.2 4000 t silo

As per system requirement as shown in drg. no. RI-2E&M/300022.

4.5.5.2.3 Conveyor gallery for single/double conveyor (above ground and overhead)

Reclaim double conveyor.  As per system requirement as shown in tender drawings.

4.5.5.2.4 System below the above Ground bunker

As per system requirement as shown in the drg no. RI-2/E&M/100028
4.5.5.2.5 Transfer houses TH 1, TH2 drive house for respective conveyors under the scope as per system requirement, refer Tender Drawing.

4.5.5.2.6 Service Buildings

a) Enclosure for site office within the Receiving Pits housing

b) First aid centre near Security post of receiving pits

c) 2 nos. lighting towers with flood lights of min. 11 m height to be provided at suitable locations

d) Light vehicle parking shed for 2 nos. of vehicles at receiving pit

e) Tool room/repair room near receiving pit

f) 1 No of Electrical switching-stations comprising of HT Switch Board Room, MCC Room, Control Room, Capacitor bank room, Battery Room, Transformer Room, Store room Maintenance Room, officer in charge room, Engineers’ Room, Supervisor/ electrician room, toilet facilities etc.

Suitable area as per requirement but not less than 60 m²

Plinth area 20 m² (minimum)

Plinth area as per requirement

Plinth area 36 m² at receiving pit (min.)

Plinth area 36 m² (min.)

Plinth area and other facilities as per system and functional requirement but not less than 220 m²

All buildings are to be designed by the bidder as per functional requirement but cannot have plinth area less than that mentioned above.

4.5.5.2.7 (a) Construction of approach roads upto receiving pits shown in the lay out drawings for plying 25T loaded tippers.

(b) Road, pavement, retaining wall, bridge, culvert etc.- As per requirement

4.5.5.2.8 Drainage, sewerage and sewage treatment for industrial and domestic sewage including septic tank, soak pits, etc. - As per requirement

4.5.5.2.9 Water supply arrangement including receiving, storage and distribution of water for potable, industrial and fire fighting purposes - As per requirement.

The size of water tank / reservoirs shall not be less than the following:

Industrial &fire fighting reservoir
1-Near groundbunker ----- 1x600 cu.m
2-Near receiving pit ----- 1x300cu.m

Drinking water (Overhead tank): all buildings as per requirement

The tank shall be covered with provision for regular inspection and cleaning.

4.5.5.2.10 Other Works and requirements

i) Development works such as grading/levelling/dressing of the site etc.
ii) Fencing/ boundary walls with gates, wherever required

iii) Architectural requirements

iv) Landscaping and Arboriculture

v) Fire fighting

vi) Dust suppression and extraction

vii) Plant cleaning

viii) Survey, Soil investigation and collection of rainfall and hydrological data

ix) Earthwork in excavation

x) Construction, Fabrication, Erection and Commissioning

xi) Inspection and testing

xii) Perception and remedial measures for safety and successful operation

xiii) Other miscellaneous works/services/requirements etc. as may be necessary for successful commissioning of the plant.

4.5.6 DETAILS OF MAIN COMPONENTS AND OTHER MISCELLANEOUS WORKS.

4.5.6.1 Receiving Pit

There are two numbers of receiving pit as shown in the lay out drawing No.RI-2/E&M/200029. Receiving Pit which is under the scope of this contract and each shall be designed and constructed for one nos. of single roll crushers & one no of coal sizer, one number lift & associated equipment. The layout and size of the receiving pit shall be as per system drawing no. RI-2/E&M/200029 Receiving pit hopper shall be lined with 52 kg rails closely spaced. Rails shall be interconnected by welding for better rigidity and stability at suitable intervals. The receiving pit complex shall receive coal from rear discharge tippers. The hopper wall shall be properly designed to withstand heavy impact caused during unloading by 25T tippers. In this context, the tenderer shall investigate the soil condition at site of construction in detail at their own cost at the time of design/construction.

There shall be one receiving hopper in each set of crushers(each set combined with one single roll & one coal sizer ). Properly anchored kerb wall as shown in the system drawing shall be provided at the dumper unloading sides of the pit for stopping the tippers and to avoid fall of tippers into the pit. The placement of RCC pedestals/structural columns for supporting roof structure of the receiving pits shall be done such that these remain well protected from the direct impact of tippers while discharging coal in the hopper. In addition, the separate RCC pedestals along with rails are also to be provided as per system drawing for protection of receiving pit columns. RCC retaining walls at the sides of the hopper shall be provided for protection of coal spillage from the heap of coal over the hopper.

In the receiving pit complex, single roll crusher shall be provided below the receiving hopper fed by means of appron feeder and from single roll crusher directly to coal sizer & feed the belt conveyor with the help of appron feeder.
suitable platform around the crusher shall be provided at the junction of upper and lower half of the crusher for the maintenance of the crusher. Apron feeder below the single roll crusher & coal sizer shall be provided. Necessary arrangements for installation of crusher with drive unit shall be made.

The apron feeder shall discharge crushed coal to conveyor through chutes. There shall be enough working space around the crusher and other equipment giving a minimum clearance of 1.5 m on the sides of all the equipment. There shall be RCC floors at different levels as indicated in system drawings. Suitable space shall be provided in all floors for maintenance and other repairs if found necessary. Necessary enclosures with proper roofing shall be provided at different floors as per requirement. Provision shall also be made for installation of rock breaker over the receiving pit at suitable locations.

Over the receiving pit, arrangement shall be made for installation of EOT crane, grab attachment, rock breaker etc. of suitable capacity as indicated in the Mechanical Section of this document for the crusher complex satisfying the operational and functional requirement. Suitable walkway should be provided along the path of the EOT cranes along with the staircase as indicated in system drawing no.RI-2/E&M/200029

By the side of receiving pit, at the top there shall be maintenance area and other infrastructures such as staircase and lift, etc. as envisaged in the relevant system drawings. Gradient of the staircase shall not be more than 40°. The maintenance space shall be provided at receiving pit top as shown in system drawings. The roof and side shall be covered with 22 gauge and 24 gauge CGI sheeting respectively with necessary wind ties. The side sheeting shall be provided all around the receiving pit from 6.0m above the ground level to top except for dumper unloading bays where it shall be from crane bracket level. The columns shall be placed in such a manner that they are safe from direct impact of tipper movement specially near receiving hoppers. All necessary inserts shall be provided in the receiving pit for installation of cables, pipes, ducts, hoists etc.

The crusher house floor shall be provided with suitable slope along and across the conveyor for proper drainage. Side drains and sumps of minimum one hour pumping capacity with steel gratings shall also be provided. Provision for installation of slurry pumps shall be made at each sump for pumping out the slurry. The entire housing arrangement of receiving hopper, crusher and apron feeder shall be free from ingress of water and shall be designed as watertight structure taking water pressure into design consideration. However, necessary control measures shall be taken to control sub soil water. The entire crusher complex shall be protected from nearby seasonal streams by means of suitable safety measures/structures.

Lighting arrangement will be made as per requirement. The area around the receiving pit should be provided with suitably designed WBM pavement for 25 Te loaded tippers. Approach road connecting the WBM Pavement around receiving pit is not in the scope of this tender. However, all approaches to the construction sites shall be made by the bidder. All along the slope of the filling around the receiving pit stone pitching along with suitable channels for proper drainage shall be provided. Properly designed retaining walls to retain the fill, wherever required and, toe walls as per requirement shall be provided for the protection of filling around receiving pit complex.
4.5.6.2 4000T silo

The silo shall be circular type with capacity to store 4000 T of coal and shall be constructed of RCC framed structure. The lay out and size of the silo shall be as per System Drg. No RI-2/E&M/300022 & RI-2/E&M/100027.

The silo shall have two pre-weigh hoppers of 72 t capacity with suitable chute for discharging coal into wagons through high speed load out.

The side slopes of the hoper shall be 60 degree to horizontal. Stair cases on both the sides of the silo to reach the silo top shall be provided. The silo top shall be fully covered. The roof and the side of the structure shall be covered with 22 gauge and 24 gauge CGI sheeting respectively.

All the facilities of maintenance, hoist, monorails etc. shall be provided as per system drawing. All the necessary inserts shall have to be provided for fixing cables, supporting structures for conveyors etc.

Foundations and construction of silo up to roof level and associated structures at the top is included in the Scope of work. In this context, the tenderer shall investigate the soil condition at site of construction in detail at their own cost at the time of design/construction.

At ground level, a railway track will be provided for loading of Unit train wagons. The laying of track is excluded from the scope of this tender. The area under silo periphery and the total areas up to 60 M x 27 M on two sides of silo along railway tracks shall have concrete pavements with minimum of 600 mm thick pre-cast or cast in situ concrete (M 20) slabs depending on the railway track requirement over at layer of stone boulder soling packed with Sand or Stone ballasts of requisite thickness. The concrete slab shall be jointed together with cement mortar 1 : 4, proper drainage shall be provided in this pavement area which could be connected to the general drainage system of the CHP Area.

Control rooms which will house electrical and control equipment including mimic panels for entire loading system including control console, CRT display and printer etc. will be constructed as per requirement. These control rooms shall be located below the silo along side the tracks with full toughened glass sheets, windows on the tracks side to facilitate clear view of the loading operation. of silo. Window panels on track side shall be 3 M (wide) by 2.5 M (height) with 6 mm thick toughened glass sheets fixed on aluminium frame. The glass pane will be minimum 1.00 M wide and 1.25 M high. The control room will have IPS flooring and covered with heavy duty PVC sheets fixed with suitable adhesive.

The control rooms will have RCC slabs and brick walls. Steel doors with glazing, conforming to I.S. Codes of Practices. All the internal surfaces of control rooms shall be plastered 13 mm thick with cement mortar 1 : 4, and painted with two coats of emulsion paints of approved shade. There shall be provision of stairs for accessibility. As the control room shall be pressurised, the entrance shall be provided with double door system to prevent pressure loss.

There shall be sufficient areas of platforms and floors below silo hopper with proper accessibility and head room for inspection and maintenance of pre weigh hopper gates and its allied equipments

In addition to the control rooms and platforms for pre weigh hopers, separate rooms with sufficient floor areas and head room will be provided to house, the power packs, compressors, dust suppression pumps including suppressant tanks (if any), the air and gas cylinders for arch breaking as well as fire extinguishing at suitable locations.
The connection between Silo hopper openings and pre weigh hopper shall be adequately designed to avoid any slippage. Stainless steel or non corrosive bolts with nuts and washers shall be provided to connect the pre weigh hopper with Silo.

The Silo shall be designed on mass flow condition so as to achieve the required loading rate without bridging, arching and rat holing inside the Silo. Internal lining of the Silo shall be as given below:

<table>
<thead>
<tr>
<th>Hopper Wall portion</th>
<th>Silo Wall (Vertical wall)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Conical Inside Wall)</td>
<td>8 mm thick stainless steel plate liners with 409 M grade steel.</td>
</tr>
<tr>
<td></td>
<td>25 mm thick ferrosite lining</td>
</tr>
</tbody>
</table>

The plate liners shall be provided /fixed in such a way as to enable its replacement in case of wear.

In anticipation of arching and bridging taking place in silo due to fluctuation in coal characteristics, suitable number of holes with necessary pipe fittings shall be provided in the Silo and hopper walls for arch breaking with the use of compressed air. These pipings shall also be used for blowing inert gas/nitrogen at high pressure into silo for fire fighting.

Roof of silo shall be of RCC construction with necessary openings for the inflow of coal. Additional openings with precast slab covers shall also be provided for inspection and maintenance of the interior of silo. Along the periphery of the silo top necessary railings shall also be provided with suitable pipe sections

4.5.6.3 Sampler house:

The sampler house shall be as per the requirement as shown in the system drawing no: RI-2/E&M/300022.

The sampler house shall be of structural steel and shall house the staircase. It shall be enclosed with CGI sheeting. Suitable opening and translucent sheeting shall be provided for natural ventilation and lighting. The staircase shall have a minimum width of 1.20 m with suitable gradient, not more than 45 with necessary landings, hand railings and accessible from lift landings. The lift and staircase shall provide access to all the floors in MCC room, control room of silo, roof or to any other floors necessary in the proposed silo. The sides of the staircase shall be properly clad as per need so that rainwater and wind shall not affect the users.

4.5.6.4 10,000Te Capacity Above-Ground Bunker

The bunker shall be above-ground type with capacity to store 10,000 tonnes of coal and shall be constructed of RCC framed structure. The layout and size of the bunker shall be as per system drawing no.RI-2/E&M/100028.

The bunker will be fed by one number tripper conveyors for which necessary supporting arrangement for tripper conveyor should be provided.

The bunker shall have two continuous slits for discharge of coal to reclaim conveyors with the help of plough feeders. Necessary supporting arrangements of adequate strength shall be designed and provided for plough feeders. The side
slope of the bunker shall be 55 degrees to horizontal. The inclined bunker slab shall be provided with 25 mm thick abrasion resistant lining of ferrosite/ironite. 2.0 m wide walkway around the bunker shall be provided at its top along with hand railings. Staircases on both the sides of the bunker shall be provided to reach the walkway platform. The bunker shall be fully covered. The roof and side of the structure shall be covered with 22 gauge and 24 gauge CGI sheeting respectively. Minimum 12% of the roofing area shall be covered with translucent sheets. Portion of roof over the bunker in between the springing and tripper houses shall be clad with provision to facilitate inspection inside the bunker from walkway platform. Suitable wind ties shall be provided.

All the facilities of maintenance, hoist, monorails, etc. shall be provided as per system drawing. The monorail for tripper shall be extended at least 1.5m beyond the top walkway of the bunker. All the necessary inserts shall have to be provided for fixing cables, supporting structures for conveyors, etc. The shelves for plough feeders shall be extended up to a minimum distance of 5 m at both ends beyond vertical wall of the above-ground bunker.

Bunker floors shall be of 200 mm thick RCC on 250 mm thick boulder soling. The grade of concrete shall be M-20 and 8 mm steel reinforcement at spacing of 150 mm centre to centre on both faces in both directions with neat cement finish. The top surfaces shall be provided with chequering of approved pattern and size of grooving. The ground bunker floor shall be provided with suitable slope along and across the conveyor for proper drainage. Single lane WBM road with black topping shall be provided all around the ground bunker and it shall be connected with the existing roads.

4.5.6.4 Aboveground arrangement for reclaim conveyors

The layout and size of the tunnel shall be as per the system drawing no RI-2/E&M/300022.1.5 metre walkway shall be provided on both sides of the conveyor. Inserts will have to be provided for installation of cable, conveyor structures, etc. The foundation for the supports provided for accommodating the conveyors below the above ground bunker shall be designed considering surcharge due to earth filling and movement of 25T loaded tippers wherever applicable. All fillings required wherever necessary along with the receiving pit is included in the scope of this tender. This includes all fillings around receiving pit and wherever required. Keeping in view the existing ground profile and future earth covering with over burden material for the receiving pit and, suitable type of supporting arrangement/foundation as well as the structure above ground shall be provided as per design requirement.

Floor shall have a slope of 1:50 to drain out water. Sumps of enough capacity on either side of the reclaiming arrangement for fixing pump shall have to be made. Proper drainage arrangement on both sides of the reclaiming arrangement shall be made so that this will be free from any ingress of water due to plant cleaning, dust suppression, seepage or otherwise and shall be designed as water-tight structure taking water pressure into design consideration. However, necessary measures shall be taken to control the inflow of water into the location arranged below the above ground bunker.
4.5.6.5 Conveyor Galleries

The details of conveyors have been shown in the tender drawings.

Gallery for Single conveyors C1 & C2 double conveyor galleries for C3 and C4 conveyors are under the scope of this contract including the installation of all these conveyors.

The existing ground profile along the conveyors has been shown in the tender drawings. Keeping in view the existing ground profile as well as water accumulation along the conveyor alignment, the supporting arrangement of the gantry for this portion is to be designed such that any part of the structure is not affected by water even during highest water accumulation. Final levelling, dressing and compaction of the filled up ground, if any, as per technical requirement along the alignment of conveyor is also included in the scope of this tender. Before start of actual construction over earth/OB filling, (Ifany) assessment of soil condition and all steps for its improvement as per design requirement are included in the scope of this tender. The foundations shall be designed in such a way that there is no appreciable settlement in due course of time. Rectification of any subsequent settlement during entire contract period is covered under the scope of this tender. Proper drainage arrangement for storm water all along the conveyor alignment considering the adjoining catchment area shall be provided. No intermediate support shall be provided inside the conveyor gallery.

The bidder may visit the site to have first hand information about ground profile and other necessary details before bidding.

4.5.6.6 On-Ground Conveyors

The conveyor shall be housed in a suitable enclosed gallery of structural steel with 1.0m walkway on one side and 0.6 meter wide catway on the other side of the conveyor. The roof covering and side cladding shall be of 22 gauge and 24 gauge CGI sheeting respectively. At least 67% of the side area shall be covered. 12% of the roofing area and 8% of the side cladding area shall be covered with translucent sheets. As part of the conveyor will be on the ground, some amount of cutting of different type of soil and rock may be required for laying out the conveyor system. The slope of cutting should not be steeper than (one horizontal to one vertical). The total width of cutting should be decided in such a way that walkways of minimum 1.5m width and rain water drain on both sides to facilitate the inspection and drainage respectively can be accommodated. The side dressing along conveyor is required in the portion where the conveyor is installed at the ground level. The supports for the conveyor as per requirement shall be provided. This part of the conveyor system is shown in the system drawing no. RI-2/E&M/200020. The levels of the ground can be seen from the system drawing. The floor of ground conveyor should be of normal flooring as per design requirement with minimum of 100 mm thick RCC over 75 mm thick mud mat concrete under laid by 150mm boulder soling packed with sand with 25 mm IPS top with grooving of approved size.

4.5.6.7 Overhead Conveyors

Overhead conveyor shall be housed in a suitable enclosed gallery of structural steel having 1.0 metre walkway on one side and 0.6 meter wide catway on the other side for each conveyor with chequered plate flooring. Hand railing shall also be provided. Detail specifications of hand rails for conveyors shall be as per relevant BIS Codes and relevant clauses of NIT and it shall be provided.
on one side of each walkway/catway. Steel trestle with RCC foundation shall be provided for supporting gallery. The bidder shall be aware about the site conditions because the site shall be handed over as it is condition. The height of trestles may be up to or more than 35 m. Four legged trestles shall be designed and provided for trestles of height 10m or above. This should also be provided at suitable intervals with due consideration to stability and permissible vibration. The trestles of the conveyors shall be so designed that the RCC portions of pedestal are 1.5m above the ground. The bidder shall make necessary approaches for fabrication and erection of the conveyor system at his own cost.

The spacing of trestle for overhead conveyor gallery should not exceed 18 metres centre to centre. However the spacing of trestles can be varied in case of crossing over haul road/obstruction/valleys with other structures which will be decided during detailed engineering stage.

Roof covering will be of 22 gauge CGI sheeting and side cladding should be of 24 gauge CGI sheeting with necessary wind ties for all conveyors. Galvanisation for sheeting shall be as per IS 277. At least 67% of the side area should be covered. 12% of roofing area and 8% of side cladding area shall be covered with translucent sheets. There shall be no tie/strut between floor beam and roof truss for conveyor gallery except side gantry connection.

Walkway and catway should be of chequered plate of 6 mm thick. Walkway shall be 1000 mm clear on one side and catway of 600 mm on the other of the single conveyor (Refer drawing No.RI-2/E&M/100026). For double conveyor gallery in addition to the central walkway as per drawing no. RI-2/E&M/100026 the walkway on both sides of the conveyor shall be of minimum 1200mm width. Overall clear width of the galleries as indicated in the system drawing are minimum. This may vary on higher side depending upon the width of walkway and width of conveyor belt and its supporting arrangement. Suitable toe guard shall be provided on the conveyor side of the walkway for protection in all the conveyor galleries.

Cross over in conveyor gallery shall be provided as required. In general cross over will be at interval of 200 m. However, this interval may be somewhat less or more at some places depending upon the location of the structures and machinery etc.

At the point of crossing sufficient clearance shall be provided between road and the conveyors, so that 25T dumpers can pass through safely. Wherever the conveyors are crossing the roads/haul road, the spacing of trestles shall be adjusted accordingly. At such locations, protective framed wire netting along with stiffener as per design shall be provided to avoid spillage of coal on roads/haul roads. It should be able to take the impact of coal lumps likely to fall and desirable thickness of coal accumulation over it. It should be accessible through properly designed stairs / ladders for periodic cleaning. The tail end of each conveyor (except Tripper conveyor) shall be extended suitably, so that spilled coal can be fed back to the conveyor.
4. 5.6.8 Transfer and Drive Houses

4.5.6.8.1 Transfer Houses TH 1, TH 2 & TH3

The typical arrangement drawings of transfer houses have been shown in relevant system drawings.

The bidder should note that design and construction of all the above transfer houses are within the scope of this tender.

**The transfer house**: The supporting structure for the transfer houses shall be of structural steel with a provision for monorail of suitable capacity and it shall be properly enclosed with CGI sheeting. Regarding the monorail capacity in different transfer houses and drive houses the bidder shall refer the Electrical & Mechanical part of this tender document. Roof and side covering shall be of 22 Gauge and 24 Gauge CGI Sheeting respectively. 12% and 8% of the roofing and side covering shall be with translucent sheeting. Proper arrangement for fixing the head drum, tail drum shall be made. Minimum of 1.5 m walkway shall be provided around all equipment. Stairs with hand railing shall be provided wherever necessary. Different floors of the transfer houses shall be made of 6 mm thick chequered plate. The ground floor for all the transfer houses shall have a PCC (1:2:4) flooring of 100 mm thickness over 100mm mud mat along with 1 M wide plinth protection and drain.

Proper safety arrangement with handrail shall be provided wherever there is opening. However, wherever handrail is not possible, toe guard will be provided. All transfer houses shall have an approach road of minimum 3.75 m width.

4.5.6.8.4 Drive House

Drive houses of suitable sizes and take up arrangement for the following conveyors are included in the scope of the tender. The drive houses shall be housed in suitable enclosed steel structures with CGI sheeting with wind ties. Roof and side covering shall be of 22 Gauge and 24 Gauge CGI Sheeting respectively. 12% and 8% of the roofing and side covering respectively shall be with translucent sheeting. The floor of the drive house shall be at least 450 mm above the final accepted ground level around the drive house. Minimum 1.5 m walkway shall be provided around the equipment. Necessary approach arrangement shall be provided for each drive house. Arrangement of monorail for handling materials shall also be kept. Floor shall be of 100 mm thick RCC over 75 mm thick mud mat over 150 mm thick boulder soling packed with sand with 25mm thick ironite floor finish. Conveyors and their drive houses.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Conveyor no.</th>
<th>Conveyor type</th>
<th>Drive House</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Conv.C1/C2</td>
<td>Each single</td>
<td>Not required</td>
<td>Drive arrangement to be accommodated in in TH1</td>
</tr>
<tr>
<td>2.</td>
<td>Conv.C3&amp;C4</td>
<td>double</td>
<td>Not required</td>
<td>Drive arrangement to be accommodated at the ground.</td>
</tr>
</tbody>
</table>
4.5.6.9 Service Buildings

General
All the buildings except otherwise mentioned below shall be of RCC framed structure construction plastered and finished with cement based paint outside. However, lighting towers, light vehicle parking, scooter / bi-cycle sheds may be of structural steel. The areas for the various service buildings to be provided shall be as given earlier. Plinth level of service buildings shall be 450 mm above final accepted graded level around the buildings. Steel doors, rolling shutters, collapsible gates and steel windows are to be fitted as per requirement. Steel windows shall be glazed with wired glass and suitable grills of square bar. All the buildings shall be given pre-construction anti-termite treatment. The floor shall be of terrazzo type or any other type depending on the functional requirement. The store floors shall be of 150 mm thick RCC M20 grade of adequate thickness of sand filling and mud matting over the base course followed by 12 mm thick ironite / ferrosite topping. The floor of the battery room shall be anti-acidic. The battery room should be provided with exhaust fan to exhaust the fumes. The internal surfaces shall be finished with plastic emulsion paint of approved shade or of any other finish depending on functional need.

4.5.6.9.1 Security Post/Time office
One no. of Security Post of 20 Sqm. near the receiving pit-II with time office with appropriate verandah opening is to be provided. These buildings are to be well designed from functional and aesthetic point of view. The buildings shall be of brickwork with RCC roofing, IPS flooring, white washed inside, cement based finish outside, angle iron door frames with flush door shutters (commercially finished), aluminium windows with glazing to be provided with approved designed grills and all necessary electrical wiring, fittings and fixtures including bulb points with CFLbulbs, tube lights suspended from the ceilings up to the level below ceiling fans level, ceiling fans, plug points, etc. The time office shall be provided with teak wood racks placed suitably for keeping cards of approximately 100 employees after punching in and punching out. These racks shall be placed such that the employees while taking out their cards for punching in or out be visible from timekeeper and should be very close to clock cum card puncher and be protected from rain splash. The time office shall have sufficient shelves and built-in almirahs with flush door shutters on angle iron frames. All the time and security offices shall have an attached toilet with urinals, WC, wash basins etc.

4.5.6.9.2 Toilet
Toilets shall be provided as per requirement. The facilities shall include water closet, urinals, washbasin looking mirror, cistern, towel rail, glass shelf, flush doors etc. The skirting up to a height of 1.5 m shall be of glazed tiles. The floorings shall be mosaic.

4.5.6.9.3 Switching station
Switching station to be constructed in this contract. The location of switching station has been shown in the system drawing. The Switching station will have transformer rooms, MCC rooms, tool room, capacitor bank room, generator room, control room, transformer room, Engineer-in-charge room, electrician room, etc. with toilet facilities. The flooring of the building will be as per the functional/safety requirement. The details of plastering, brick work, RCC work will be as per
technical specification which has been mentioned elsewhere in this document. The details of equipment have been mentioned in the electrical sections of the document. The layout of the cable trench will be as per system requirement. The invert level of the cable trench shall be kept minimum 0.5 m above finished ground levels and the plinth of the building shall be fixed accordingly. The building shall be provided with RCC roof. There will be suitable arrangement for lifting the transformer in case of breakdown/maintenance for which suitable RCC paved platform shall be constructed at same level out side the substation building to facilitate handling of the transformer and other equipment. The scope covers construction of complete building with cable trench and foundation of the equipment in all respect.

Pressurisation in MCC rooms of sub-station shall be done. Air conditioning facilities shall be provided in all control/PLC rooms of sub-station. The entrance to both the MCC room, control room/PLC room shall have double doors suitably designed to prevent sudden pressure loss. The flooring in MCC room and switchgear room shall be of IPS with insulating rubber matting. Air required for pressurisation of MCC room shall be free of dust. For this, adequate arrangements for cleaning, filtering and treatment of air to maintain the desired humidity shall be included with scope of work. In case of Control and MCC rooms, the sound level within the rooms should be kept below 60dB.

4.5.6.10 Roads and Pavement

4.5.6.10.1(a) Construction of approach road upto receiving pit: The proposed approach road shall be designed taking into consideration the CBR value of the soil for plying 25 T loaded tippers. The tentative route has been indicated in the key plan.
(b) Roads: Whole of the proposed CHP area shall be well connected with single lane black topped roads for movement of men and materials. Scope of this tender is restricted to construct road net work between receiving pit to silo. These shall be well connected by single lane road. These roads shall have 3.75 m wide carriage way with minimum 1.5 m wide shoulders and drains of suitable dimension and specification on both sides of the road. The road shall be designed for movement of LMVs like cars, jeeps, trucks, rubber tyres mounted mobile cranes etc., considering the prevailing soil conditions. Suitable culverts/bridges if required for free flow of surface drainage shall be properly designed and provided.

4.5.6.10.2 Pavement
Pavement shall be provided in the surrounding area of Drive Houses and Transfer Houses for a width of 2.0 meter and in other places as required for smooth functioning of the CHP. Pavement for other places.

i) Well prepared and compacted sub-grade.250 mm thick (rolled, compacted and finished thickness) stone boulder interlocked soling as sub-base including blinding of interstices with stone spalls and sand and finally watered and rolled. 200 mm thick RCC with M 20 grade concrete and 8mm dia. reinforcement mesh at a spacing of 150 mm centre to centre on both faces in both direction trowelled smooth finish on top and provided with chequered on top wearing surfaces of approved pattern and approval sizes of grooving.

The slope across pavement shall be 1:50 for proper drainage. However, the slope along the ramp of entrances shall not be steeper 1:10 . At the entry edges of pavement for parking, there may be suitable drains covered with suitably designed perforated RC covers.
ii) WBM Pavement around receiving pit complex. Water bound macadam (WBM) pavement without black topping shall be provided around Receiving Pit - II at RL as shown in key plan. The WBM pavement shall be designed to meet the requirement of plying 25T loaded tippers. Before laying the WBM pavement, it shall be ensured by the bidder that filling around each receiving pit area is well compacted. The slope across the pavement shall be 1:50 for proper drainage. Drains of suitable dimensions and specifications shall also be provided around the pavement.

4.5.6.11 Drainage and Sewerage Arrangements

4.5.6.11.1 Drainage Arrangements
Proper surface drainage facilities of adequate dimensions, specifications and slope shall be provided for the entire proposed CHP (Scope covered by this tender only)

4.5.6.11.2 Sewerage
Proper sewerage system shall be provided for handling and treatment of domestic sewage. This will include provision of septic tank, soak pit, sewer line, man hole, inspection chamber, all other fittings and fixtures etc. needed for the same.

The industrial effluent from Plant area (Scope covered by this tender only) after collection floor washing, dust suppression and extraction shall be collected and conveyed through a separate sewerage system.

4.5.6.12 Services

4.5.6.12.1 Drinking water
Individual PVC/RCC over head tanks of required capacity but not less than 5 m$^3$ capacity shall be provided over each sub-stations, offices, and other service buildings as per requirement. Necessary receiving and distribution piping and pumping arrangement shall be covered in the scope of the tender. Adequate drinking points shall also be provided at all drive houses, transfer points, tunnel, Receiving pit, etc. The distribution system for drinking water shall be done as per requirement. The facility for drinking water shall be provided at suitable points in offices, service buildings, toilets, etc. with all necessary fittings and fixtures.

4.5.6.12.2 Industrial / fire fighting water
One on-ground reservoir of 300 m$^3$ at Crushing Complex shall be provided. There will be a dwarf wall in the reservoir. The dwarf wall should be constructed in such a way that a minimum capacity of 200 m$^3$ of water should be reserved for fire fighting purpose. Another on-ground reservoir of 600 m$^3$ capacity should be provided near on-ground bunker with same arrangement.

The capacities of the tanks/reservoirs other than main reservoir shall be fixed after calculation of water requirement on the basis of relevant norms/system requirements but shall not be less than those as mentioned earlier. All on-ground reservoirs and over head tanks shall be covered, with provision of necessary free board, ladders etc. Water supply lines and arrangements shall be provided for fire fighting and dust suppression and extraction as explained elsewhere. Necessary pumping facilities shall also be provided.
The sources for filling these reservoirs shall be from the main reservoir. All piping and pumping arrangement for drinking and including pump house from this reservoir to feeding points shall be in the scope of this contract.

4.5.6.13 Other works/requirements

4.5.6.13.1 Development works such as Grading/levelling/dressing of site, etc

Site grading/levelling shall be done by the bidder within boundary limit of the proposed CHP area under the scope of this contract based on detailed survey to be done by the bidder as per technical/functional and drainage requirement.

4.5.6.14 Architectural requirements

The structures in the whole CHP complex (under the scope of this contract) shall have appropriate industrial architectural look, with appropriate colour, shades and structural networks. All the structures should portray architectural excellence with due care to better utilisation of space, service requirements etc. and also encompass concerns as varied as contemporary design, area conservation and environmental issues. The buildings with brick work, concrete and plaster faces shall have cement based paints in aesthetically sound shades as approved and all steel structures shall have oil based paints with louvers and openings for ventilation and better use.

4.5.6.14.1 Landscaping and Arboriculture

The whole CHP complex (under the scope of this contract) shall be designed keeping in view its proper aesthetic appearance. The perspective view of the plant with landscaping shall be submitted. To provide better environment and arrest dust around CHP, intensive close planting of Casia Siamed or approved variety should be done to form impervious hedges around the plants and shall be maintained by bidder for the period of two years after plantation. The boundary limit of the entire CHP for the purpose of development and arboriculture shall be limited up to a distance of 25 m from the edge of various infrastructures of the CHP.

4.5.6.14.2 Survey, Soil investigation and Collection of rainfall and hydrological data

No data regarding above are made available in this tender document. The bidder is required to inspect and examine the site and its surroundings and satisfy himself as to the nature of ground, rainfall and the soil, the availability and suitability of other requirements, as required for fair bidding purposes. The successful bidder shall have to undertake detailed survey, detailed soil investigation and collection of hydrological data, rainfall data, prepare and submit a comprehensive soil report with recommendations for type of foundation, bearing capacities, method of deep excavation, probable settlement for foundations etc. for approval of the owner/consultant. Reports approved by the owner/consultant shall be finally adopted for design and engineering. Soil investigation should be done in the presence of the owner/consultant. No extra claim shall be made over contract price for variation in soil, rainfall and hydrological investigation reports which may result in change of design and type of foundation unless otherwise stated. All works related to site survey shall be conducted as per standard practice and also as per system requirement.
4.5.6.14.3 Earthwork in excavation

Excavation of earth for all types of soil for construction of all the civil structures is covered in the scope of this contract. Final dressing of ground in and around the proposed CHP area is under the scope of this contract for drainage will be done by the contractor as per technical and functional requirement. After completion of work ground will be provided in as it is condition. Excavation for proper drainage of rain/ subsoil water around the underground tunnel, ground conveyor, service buildings, transfer houses, drive houses, receiving pit area, substations etc. is covered under the scope of this tender. The depth and size of the excavation will be as per approved system requirement and as per detail design drawings. All cuttings and fillings as per required level and profile including transportation/ disposal of soil within a distance of 2 km is included in the scope of this bid.

4.5.6.14.4 Earthwork in receiving pit & the area for the arrangement below the above ground bunker

Pavement around receiving pit complex will be at RL as shown in key plan. All filling as per required level and profile around receiving pit and tunnel for conveyors up to pent house shall be done in layers by the bidder with OB materials which shall be obtained from the quarry in consultation with BCCL. All large size boulders shall be removed or broken before filling.

Bidder shall ensure proper consolidation and stability of the pavement area and its embankment suitable for plying 25T loaded tippers. Toe wall, dwarf wall or retaining wall, as required, to protect the embankment shall be provided by the bidder. Side slopes will have boulder pitching of minimum 200 mm thickness with suitable drainage channel. The entire pavement, tunnel area and embankment will also be provided with proper drainage arrangement.

4.5.6.14.5 The HFL, Bed level, water flow, etc. of the existing water courses, sub-soil water table shall be taken into consideration while designing the structures. Bidder shall undertake various remedial measures for protection of the proposed CHP area from streams/water courses as per requirement.

4.5.7 Construction, Fabrication, Erection and Commissioning, overheads and supervision

4.5.7.1 Clearance of site before start of work

Site will be handed over to the contractor in ’as it is’ condition. Any site preparation work including cleaning, cutting, filling, levelling, grading, removal, etc. before start of the actual work shall be done by the contractor to the full satisfaction of Engineer-in-charge.

a) Site Clearance after completion of work

After the completion of work the contractor shall remove scaffolding, sheds rubbish and surplus materials except which are required for rectification of defects. Contractor shall hand over the site in clean and tidy condition after cleaning the total area including floor, drains etc. fit for the use by the owner.
b) Layout and Levels

The layout and levels of all structures, etc. shall be laid by the contractor at his own cost from the general grid of the plot and bench marks given by the Engineer-in-charge for checking the detailed layout and correctness of the layout and levels. But the contractor shall be solely responsible for correctness of layout and levels.

4.5.7.2 Specifications

The specifications are intended for general description of the work, quality and workmanship. The specifications are not, however intended to cover minute details and the work shall be executed according to the relevant Indian Standard codes of practices or to the recommendations of relevant American and British Standard in cases where Indian Standard codes are not available for such works. These specifications shall have precedence in anything contrary to this stated anywhere in this document. Some important and relevant BIS Codes to be followed are mentioned in the Technical specifications attached hereto.

4.5.7.3 Construction Method and Equipment

The Contractor shall submit drawings and write ups indicating a broad outline of how he intends to execute the work.

4.5.7.4 Installation/Erection and Supervision

It will be the contractor's responsibility to bring, receive and keep the materials in safe custody in proper condition. Responsibility of handling the materials during manufacturing, transit and handling at site rests with the contractor.

All the equipment will have to be installed and fitted with accessories as per approved drawing. Entire tools and tackles, manpower and any other material required for successful installation will be supplied by the contractor. The contractor shall furnish the list of requirement of engineers, supervisors and other skilled personnel to carry out the job properly.

4.5.8 Inspection and testing

Test for Material/Workmanship

All tests required for materials, quality of work and any other tests as required/desired by the Engineer-in-charge shall be at Contractor's cost. The frequency and mode of testing shall be as per latest relevant BIS codes.

4.5.9 Perception and remedial measures

Perception and remedial measures for the entire CHP area under the scope keeping in view the adjoining natural and artificial features such as hill slopes, nallah, buildings, silos etc.

4.5.10 Other miscellaneous works/services/requirements etc.

All brick work, doors, windows, finishes including architectural treatment, plinth protection, water proofing, damp proofing, glazing etc.
All brickwork shall be carried out as per relevant IS codes and shall be plastered on both faces with 12mm thick cement mortar 1:6 (cement/sand). All external walls shall be of minimum 250 mm thick. RCC ceiling shall be plastered with 6 mm thick plaster. The scope also includes providing and fixing all doors, windows, rolling shutters, finishes, damp proofing, inserts, anchor bolts, embedment, stairs nosing, railings ladders, edge protection angle, etc. Doors and windows shall be of aluminium frames and suitably glazed. Openings on external walls of the buildings shall be provided with sunshades.

All equipment foundations. All inserts, anchor bolts and embedment.
All railings, ladders and platforms.

All necessary wind ties
Cable trenches shall be provided with chequered plate or with pre-cast RCC covers. Cable trenches as well as pre-cast cover shall be provided with edge protection angles. All embedment/block cuts as required elsewhere in these specifications shall be provided, or cable tray can also be provided.

All external surface of underground concrete structure except receiving pit and underground tunnel in contact with earth shall be given a bitumen coat. 600 mm thick boulder packing shall be provided on the outside face of earth retaining structures. Weep holes shall be provided at suitable spacing in all earth retaining structure or as per design requirement.

All corners and edges in openings shall be protected with angle of minimum size 75 mm x 75 mm x 8 mm with suitable lugs embedded in concrete. Similarly all edges of concrete members coming in contact with flow of coal or any other moving material shall be provided with similar edging for protection.

Floodlight towers and crossovers shall be provided wherever required. Monorail girders and fixtures shall be provided for monorails at locations required and described elsewhere in these specifications or drawings.

All RCC work to be done under this specification unless specified, otherwise, shall be of controlled concrete of grade not less than M-20 of IS 456 (Latest) and shall be made with fresh cement.

All structural steel work shall have one shop coat and one site coat of red oxide zinc chromate and two field coats of synthetic enamel paints as specified elsewhere. However, bidders are to mention the thickness of painting in microns.

Locations of trestles and foundations for conveyor galleries shown in the tender drawings are only tentative and may undergo variations, depending on detailed engineering in the concerned area.

Gradient of the staircase should not exceed 40 degree and there should not be monkey ladders. Proper shed should also be provided above the staircases wherever the stairs are outside.

Any other works/services/requirements whether specifically indicated or not and found necessary to be incorporated on later date for safety and efficient operation of the plant shall also be deemed to have been covered within the scope of work of this tender.
4.5.11 Safety

4.5.11.1 Safety Code – General Suitable scaffolds shall be provided for workmen for work that cannot safely be done from the ground or from solid construction except such short period work as can be done safely from ladders. When a ladder is used an extra mazdoor shall be engaged for holding the ladder and if the ladder is used for carrying materials as well, suitable foot holds and hand holds shall be provided on the ladder and the ladder shall be given an inclination not steeper than 1/4 horizontal to 1 vertical. Scaffolding or staging more than 3.25 metres above the ground or floor, slung or suspended from an overhead support or erected with stationary support shall have a guard rail properly attached, bolted, braced and otherwise secured at least 1 metre high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such opening as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structures. Working platform, gangways and stairways shall be so constructed that they do not suddenly or unequally change level, and if height of a platform or gangway or stairway is more than 1.25 metre above ground level or floor level, it shall be closely boarded, have adequate width and be suitably fenced, as described above. Every opening in floor of a building or in a working platform shall be provided with suitable means to prevent fall of persons or materials by providing suitable fencing or railing with a minimum height of 1 metre.

a) Safe means of access shall be provided to all working platform and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 metres in length. Width between side rails in a rung ladder shall in no case be less than 30 cm for ladders up to and including 3 metres in length. For longer ladders this width shall be increased at least 6 mm for each additional 30 cm of length. Uniform step spacing shall not exceed 30 cm. All scaffolding, ladders and other safety devices mentioned or described herein, shall be maintained in safe condition and no scaffold, ladder or equipment shall be altered or removed while it is in use.

b) Adequate precautions shall be taken to prevent danger from electrical equipment. When workers are employed on electrical installations which are already energised, insulating mats, working apparel such as gloves, sleeves and boots, as may be necessary shall be provided. Workers shall not wear any rings, watches and carry keys or other materials which are good conductors of electricity.

d) No materials on any of the sites shall be so stacked or placed as to cause danger of inconvenience to any person or the public.

e) The contractor shall provide all necessary fencing and lights to protect public from accident and shall be bound to bear expenses of defence of every suit action or other proceedings at law that neglect of the above precautions and so pay any damages and costs which may be awarded in any such suit, action or preceding in such persons or which may with the consent of the contractor be paid to compromise any claim by any such person.

f) Excavation and Trenching - All trenches, 1.6 metres or more in depth, shall at all times be supplied with at least one ladder for each 20 metres in length or fraction thereof. Ladder shall be extended from bottom of trench to at least 1
metre above surface of the ground. Sides of a trench which is 1.5 metres or more in depth shall be stepped to give suitable slope or securely held by timber bracing, so as to avoid the danger of sides collapsing. Excavated materials shall not be placed within 1.5 metre of edge of trench or half of depth of trench, whichever is more. Cutting shall be done from top to bottom. Under no circumstances shall undermining or undercutting be done.

g) Demolition - Before any demolition work is commenced and also during the process of the work:

All roads and open areas adjacent to the work-site shall either be closed or suitably protected.

No electric cable or apparatus which is liable to be a source of danger over a cable or apparatus used by operator shall remain electrically charged.

All practical steps shall be taken to prevent danger to persons employed from risk of fire or explosion, or flooding. No floor, roof or other part of a building shall be so overloaded with debris or materials as to render it unsafe.

All necessary personnel safety equipment as considered adequate by the Engineer-in-charge shall be available for use of persons employed on the site and maintained in a condition suitable for immediate use, and the contractor shall take adequate steps to ensure proper use of equipment by these concerned.

Workers employed on mixing asphaltic materials, cement and lime mortar / concrete shall be provided with protective gloves.

Those engaged in handling any materials which is injurious to eyes shall be provided with protective goggles.

Those engaged in welding works shall be provided with welder's protective eyes shield.

When workers are employed in sewers and manholes which are in use, the contractor shall ensure that manhole covers are opened and manholes are ventilated at least for an hour before workers are allowed to get into them. Manholes so opened are cordoned off with suitable railing and provided with warning signal or boards to prevent accident to public.

Stone breaker shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.

The contractor shall not employ man below the age of 18 and women on the work of painting with products containing lead in any form. Whenever men above the age of 18 are employed on the work of lead painting, the following precautions shall be taken:

i) No paint containing lead or lead products shall be used except in the form of paste or ready made paint.

ii) Suitable face masks shall be supplied for use by workers when paint is applied in the form of spray or when a surface having lead paint is being dry rubbed and scraped.

iii) Overalls shall be supplied by the contractor to workmen and adequate facilities shall be provided to enable working painters to wash during and on recession of work.
Use of hoisting machines and tackle including their attachments, anchorage and supports shall conform to the following:

i) These shall be of good mechanical construction, sound materials and adequate strength and free from patent defects and shall be kept in good repair and in good working order. They shall be regularly tested and certified as appropriate.

ii) Every rope used in hoisting or lowering material or as a means of suspension shall be of durable quality and adequate strength and free from patent defects.

iii) Every crane driver of hoisting appliance/ operator shall be properly qualified and no person under the age of 21 years shall be in charge of any hoisting machine including any scaffold, winch or give signals to operator.

iv) In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hoisting or lowering or as means of sub-tension, safe working load shall be ascertained by adequate means. Every hoisting machine and all gear referred to above shall be plainly marked with safe working load. In case of a hoisting machine having a variable safe working load and the conditions under which it is applicable shall be clearly indicated. No part of any machine or of any gear referred to above in this paragraph shall be loaded beyond safe working load except for the purpose of testing.

v) In case of departmental machine, safe working load shall be notified by Engineer-in-charge. As regards contractor's machine, the contractor shall notify safe working load of each machine to the Engineer-in-charge wherever he brings it to site of work, and shall get it verified by the Engineer-in-charge.

vi) Motors, gearing, transmission, electric wiring and at near dangerous parts of hoisting appliance shall be provided with efficient safeguards.

vii) Hoisting appliances shall be provided with such means as will reduce to the minimum risk of accidental descent of load. Adequate precautions shall be taken to reduce to the minimum risk of any part of a suspended load becoming accidentally displaced.

Adequate washing facilities shall be provided at or near places of work.

4.5.11.2 Application: These safety provisions shall be brought to the notice of all concerned by display on notice board at a permanent place at the work spot. Persons responsible for ensuring compliance with the safety code shall be named by the contractor. To ensure effective enforcement of the rules and regulations relating to safety precautions, arrangements made by the contractor shall be open to inspection by the Engineer-in-charge or his representatives and the Inspecting Officers as defined in the contractor's Labour Regulations.

When work is done near any place where there is risk of drowning, all necessary safety and rescue equipment shall be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provision made for prompt first aid treatment for all injuries likely to be sustained during the course of the work.
Notwithstanding the above conditions 1 to 14 the contractor is not exempted from the operation of any other Act or Rules in force.

4.5.11.3 GENERAL REQUIREMENTS

a) Any other requirement whether specifically indicated or not, but found necessary to be incorporated at a later date for safe and efficient operation of the plant shall also be deemed to have been covered within the scope of work of this tender.

b) Wherever required dewatering shall be done by the contractor to avoid damage of equipment, structural, etc. and timely completion of work.

If any certification or approvals are to be taken from electrical inspector/statutory bodies, DGMS, the same shall be the responsibility of the contractor.

As per system requirement envisaged in the NIT documents, various parameters, specifications may undergo changes during detail engineering stage. This shall be carried out by the contractor without any increase in cost.

All safety regulations, code of practices for power supply, manufacturer, installation, erection, commissioning etc. envisaged by the State Govt./Central Govt. or any authorities/bodies shall be strictly complied without any increase in cost. All Mines Acts and regulations will be followed during construction stage.

4.5.12 OTHER ITEMS

4.5.12.1 Weight and Volume Clause

The quantities shall be within reasonable accuracy. Any variation in quantities on higher side from quoted to during actual execution will not entitle the contractor for any additional claim, while for short fall in the quantity up to 10% no recovery/adjustment shall be made by the Owner. However for shortfall in quantities beyond 10% during actual execution, proportionate reduction in cost of contract for the relevant amount for respective items of civil and structural works will be made. For example - if the quoted quantity of the structural steel is 100 Te and as per actual execution it comes to 85 Te, the proportionate reduction in cost against structural steel will be 5% of the quoted price for structural steel. As such the bidder should work out the quantities with utmost care.

The quantities of various items for "Civil & Structural Works" mentioned as below should be indicated in the price bid only.

<table>
<thead>
<tr>
<th>Civil and structural work</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Earthwork in cutting receiving pit/above-ground bunker &amp; approach road upto receiving pit cum</td>
</tr>
<tr>
<td>Earthwork in cutting others cum</td>
</tr>
<tr>
<td>2  a) Earthwork in filling cum</td>
</tr>
<tr>
<td>b) Sand filling cum</td>
</tr>
<tr>
<td>3  PCC at all levels as per system requirement cum</td>
</tr>
<tr>
<td>a) 1:4:8 cum</td>
</tr>
<tr>
<td>b) 1:2:4 cum</td>
</tr>
<tr>
<td>4  RCC (excluding reinforcement) cum</td>
</tr>
<tr>
<td>a) M20 cum</td>
</tr>
<tr>
<td>b) M25 cum</td>
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<td>Item</td>
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<td>10</td>
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<td>11</td>
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</tbody>
</table>

**Quantity and price break-up of Developmental work and infrastructure**

- Site Development
- Sewerage
- Arboriculture
- Water supply & pipe line 150mm dia
- Pump house
- Haul Road diversion
- Sub-station building
- Office, security office, first aid centre and tool room (60+36+20+36)m²
- Parking shed
- Lighting Toter
- Underground reservoir
- Overhead reservoir
- Internal road 3.75m wide
- Pavement for receiving pit
- 2 number culverts 1.22m span
- Drains with average size 30cmx40cm
### Annexure-III.

#### 1. LIST OF MECHANICAL EQUIPMENT AND ACCESSORIES

**A: LIST OF EQUIPMENT**

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Particulars</th>
<th>Capacity</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>MECHANICAL (List of equipment)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i</td>
<td>Rapid loading system (silo-4000)</td>
<td>4000 Te</td>
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</tr>
<tr>
<td>ii</td>
<td>Preweight hoppers,</td>
<td>72 Te</td>
<td>2</td>
</tr>
<tr>
<td>iii</td>
<td>Primary single roll crusher</td>
<td>1200 tph</td>
<td>2</td>
</tr>
<tr>
<td>iv</td>
<td>Twin shaft coal sizer</td>
<td>1200 tph</td>
<td>2</td>
</tr>
<tr>
<td>v</td>
<td>Appron feeder, length 7mtrs, width 2.4mtrs</td>
<td>1200 tph</td>
<td>2</td>
</tr>
<tr>
<td>vi</td>
<td>Motorised Hoist</td>
<td>No</td>
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<tr>
<td>vii</td>
<td>Automatic Coal sampling system</td>
<td>set</td>
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</tr>
<tr>
<td>viii</td>
<td>Plough feeder</td>
<td>1800 tph</td>
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<tr>
<td>ix</td>
<td>Magnetic separator</td>
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<tr>
<td>x</td>
<td>Metal detector</td>
<td></td>
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<tr>
<td>xi</td>
<td>Hydraulic Rock Breaker, 45 KW</td>
<td></td>
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</tr>
<tr>
<td>xii</td>
<td>Grab 15 KW attachment</td>
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<td>2</td>
</tr>
<tr>
<td>xiii</td>
<td>Chute assembly with liner</td>
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<td>12</td>
</tr>
<tr>
<td>xiv</td>
<td>Vibratory feeder 22 KW, 600tph.</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>xv</td>
<td>Safety &amp; fire fighting system and plant cleaning system</td>
<td>set</td>
<td>One lot</td>
</tr>
<tr>
<td>xvi</td>
<td>Belt cleaning device</td>
<td>No</td>
<td>3</td>
</tr>
<tr>
<td>xvii</td>
<td>Belt pulling device</td>
<td>No</td>
<td>3</td>
</tr>
<tr>
<td>xviii</td>
<td>Dust suppression/extraction system with piping &amp; other accessories</td>
<td>One complete set</td>
<td>As per demand</td>
</tr>
<tr>
<td>xix</td>
<td>Lift and ventilation at receiving section for crushers and others</td>
<td>As required</td>
<td>2</td>
</tr>
<tr>
<td>xx</td>
<td>Miscellaneous items like tools &amp; tackles, (7 nos) chain pulley blocks, belt vulcanising system (2nos) grizzly etc.</td>
<td>Adequate for the plant</td>
<td></td>
</tr>
<tr>
<td>xxi</td>
<td>Belt conveyor(C1), 1400 mm, 165 m, 210 kw</td>
<td>1200 tph</td>
<td>1</td>
</tr>
<tr>
<td>xxii</td>
<td>Tripper conveyor C2 1400mm, 110m, 90 kw</td>
<td>1200 tph</td>
<td>1</td>
</tr>
<tr>
<td>xxiii</td>
<td>Conveyor C3 &amp; C4, 1400mm, 485m 2x220 kw</td>
<td>1200 tph</td>
<td>2</td>
</tr>
<tr>
<td>xxiv</td>
<td>Nilon/Nilon 1400mm, 800/4, 5/3 km</td>
<td>km</td>
<td>2.6</td>
</tr>
<tr>
<td>xxv</td>
<td>Two way chute for tripper</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>xxvi</td>
<td>Beltweighers, 1400mm wide, 1200 tph, 2.85m/sec</td>
<td>1200 tph</td>
<td>2</td>
</tr>
<tr>
<td>xxvii</td>
<td>ventilation</td>
<td>Adequate for the plant</td>
<td></td>
</tr>
<tr>
<td>xxviii</td>
<td>Condition monitoring system</td>
<td>As per list</td>
<td></td>
</tr>
<tr>
<td>xxix</td>
<td>Miscellaneous equipment &amp;facilities</td>
<td>As required</td>
<td></td>
</tr>
<tr>
<td>xxx</td>
<td>Safety equipment</td>
<td>As per requirement</td>
<td></td>
</tr>
<tr>
<td>xxxi</td>
<td>Spare parts</td>
<td>As per requirement</td>
<td></td>
</tr>
<tr>
<td>xxxii</td>
<td>Any Other item if,</td>
<td>As per requirement</td>
<td></td>
</tr>
</tbody>
</table>

Sub-Total(C.1.1)
### B: LIST OF ACCESSORIES AND FACILITIES

<table>
<thead>
<tr>
<th>Nomenclature</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous bin level indicator</td>
<td>Minimum 1 (One in each crush box of crusher house)</td>
</tr>
<tr>
<td>Gas cutting set</td>
<td>3</td>
</tr>
<tr>
<td>Portable welding set (it should be 3-phase)</td>
<td>4</td>
</tr>
<tr>
<td>Portable compressor for plant cleaning 30 cfm capacity 6 kg/cm² Pressure</td>
<td>2</td>
</tr>
<tr>
<td>Belt vulcanising machine-hydraulic type Suitable for belt width up to 1600 mm for N-N belting</td>
<td>1</td>
</tr>
<tr>
<td>Special tools and tackles</td>
<td>As received along with the equipment supplied</td>
</tr>
<tr>
<td>Consumables for start up including first and second fill of lubricants</td>
<td>As required</td>
</tr>
<tr>
<td>Noise abatement measures to reduce noise level</td>
<td>As required</td>
</tr>
<tr>
<td>Measures to control vibration so as to keep its level within ISO limits</td>
<td>As required</td>
</tr>
<tr>
<td>Items/accessories not specifically mentioned but needed for successful commissioning/operation of the plant.</td>
<td>As required</td>
</tr>
<tr>
<td>Belt replacing equipment</td>
<td>2</td>
</tr>
</tbody>
</table>
## 2 ELECTRICALS (list of equipment)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Specification</th>
<th>Unit</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Two nos 6.6 kV single circuit three phase OHT line with WOLF conductor each of 4kM (Approx) and another section of 6.6kV OHT line with WOLF conductor of Approx length 0.5 km</td>
<td>Km</td>
<td>8.5</td>
</tr>
<tr>
<td>2</td>
<td>20 no.6.6 kV VCB complete with metering &amp; protection in panel configuration</td>
<td>panel</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>6.6 KV A.B.Switch</td>
<td>nos</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>6.6 KV Lightening arrester</td>
<td>nos</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>6.6 KV Capacitor bank</td>
<td>set</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Power factor control panel</td>
<td>no</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>6.6 / 0.44 kV indoor type power transformer 1000kVA</td>
<td>no</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>6.6 / 0.44 kV indoor type power transformer 500kVA</td>
<td>no</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>6.6 / 0.440 kV Lighting transformer 200 kVA</td>
<td>no</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>6.6 KV circuit breakers</td>
<td>no</td>
<td>3</td>
</tr>
<tr>
<td>11</td>
<td>440 V Motor Control Centres (MCC) for supply of power to LT Motors</td>
<td>no</td>
<td>3</td>
</tr>
<tr>
<td>12</td>
<td>Control System</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>13</td>
<td>1.1/0.650 kV Control &amp; signaling cables</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>14</td>
<td>Earthing System</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>15</td>
<td>Earthing strips / wires / conductors, ground electrodes, earthing pits etc.</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>16</td>
<td>Lightning protection system for building and structures</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>17</td>
<td>Equipment &amp; accessories for pressurization</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>18</td>
<td>Air conditioners</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>19</td>
<td>Local control stations</td>
<td>no</td>
<td>As required</td>
</tr>
<tr>
<td>20</td>
<td>Voltage stabilizers for control circuits</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>21</td>
<td>Computer and laptop</td>
<td>no</td>
<td>As required</td>
</tr>
<tr>
<td>22</td>
<td>Project Administrative Communication System with telephone sets</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>23</td>
<td>Industrial Duplex Loud Hailing Intercom System</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>24</td>
<td>Any other item</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>25</td>
<td>Power &amp; Control cables of different rating &amp; sizes,</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>26</td>
<td>6.6 KV grade Power cables</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>27</td>
<td>1.1 KV grade Power cables</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>28</td>
<td>1.1 KV grade Lighting cables</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>29</td>
<td>Fire Fighting</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>30</td>
<td>Cable trenches, soak pits etc.</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>31</td>
<td>Welding system</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>32</td>
<td>Transformer welding set complete with cable and accessories</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>33</td>
<td>Motor generator welding set complete with cable and accessories</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>34</td>
<td>Welding sockets complete with switches, holder set etc.</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>35</td>
<td>Welding cables</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>36</td>
<td>Testing equipment</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>37</td>
<td>Telecommunication</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>38</td>
<td>Misc.(Illumination etc and others)</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>39</td>
<td>230V(L-L) Main Lighting distribution boards</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>40</td>
<td>230V(L-L) Lighting Distribution Boards</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>41</td>
<td>Fluorescent fixtures complete with control gears accessories etc.</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>42</td>
<td>High pressure sodium vapour lamps complete with control gears accessories etc.</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>43</td>
<td>Street lighting poles/brackets</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>44</td>
<td>Junction boxes complete with fuse terminal block &amp; other accessories</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>45</td>
<td>400 kVA DG sets for emergency light</td>
<td>No</td>
<td>2</td>
</tr>
<tr>
<td>46</td>
<td>Digital clock with accessories for automatic switching ON/OFF of street lights</td>
<td>Lot</td>
<td>As required</td>
</tr>
<tr>
<td>47</td>
<td>Any Other item</td>
<td>Lot</td>
<td>As required</td>
</tr>
</tbody>
</table>

**SUS-TOTAL (C:1.2)**
## LIST OF ELECTRICAL EQUIPMENT, ACCESSORIES AND TESTING EQUIPMENT

### A: LIST OF ELECTRICAL EQUIPMENT AND ACCESSORIES

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Equipment</th>
<th>Quantity</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6.6kV, 3phase overhead transmission line with WOLF conductor</td>
<td>8.5 km</td>
<td>One circuit of 4km (Approx) from proposed 2x10 MVA sub. Station of block III OCP (Source-I) to 6.6 kV switching station &amp; another circuit of 4 km (approx) from alternate source i.e Source-II (To be decided &amp; identified by BCCL) to 6.6kV switching station &amp; 0.5 KM (Approx) from 6.6 kV switching station to MCC-III</td>
</tr>
<tr>
<td>2.</td>
<td>6.6 kV Lightning arrestors as per technical specification.</td>
<td>6nos.</td>
<td>2nos. Each at receiving end &amp; 2nos at sending end</td>
</tr>
<tr>
<td>3.</td>
<td>6.6 kV Isolators with earthing switch as per technical specification</td>
<td>6nos.</td>
<td>2nos. each at receiving end &amp; at sending end</td>
</tr>
<tr>
<td>4.</td>
<td>6.6 kV Switchboard comprising of 2 nos for trunking of incoming cable and consists of 18 nos of 6.6 kV Vacuum Circuit Breaker / contactor panel complete with metering and protection system (Refer drawing no. RI-2/E&amp;M/000031 and technical specification) for incoming, &amp; supply of power to BC1, BC3, BC4, plough feeder, coal sizer, crusher, transformer etc</td>
<td>1 No.</td>
<td>6.6kV Switching station room</td>
</tr>
<tr>
<td>5.</td>
<td>6.6/0.440 kV, 1000 kVA Distribution transformer (Refer drawing no RI-2/E&amp;M/000031 and technical specification)</td>
<td>2 Nos</td>
<td>2nos at 6.6kV Switching station room</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Quantity</td>
<td>Location</td>
</tr>
<tr>
<td>---</td>
<td>--------------------------------------------------------------------------------------------------</td>
<td>----------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>6</td>
<td>6.6/0.440 kV, 500 kVA Distribution transformer (Refer drawing no RI-2/E&amp;M/ 000031 and technical specification)</td>
<td>2 Nos</td>
<td>2nos at SILO, MCC-III room</td>
</tr>
<tr>
<td>7</td>
<td>6.6/0.440 kV, 200 kVA Lighting Transformer (Refer drawing no RI-2/E&amp;M/ 000031 and technical specification)</td>
<td>2Nos.</td>
<td>1 no. at 6.6kV Switching station room &amp; 1 no. at SILO, MCC-III room</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Equipment</td>
<td>Quantity</td>
<td>Location</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------------------------------------------------------</td>
<td>----------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>8</td>
<td>440 V Motor Control Centre (MCC -1) comprising of 1 no. of incomer &amp; one no outgoing Feeders for supply of power to LT Motors of equipment like apron feeder, magnetic detectors, magnetic separator, Electrical Hoists, hydraulic rock breaker, grab attachment, etc (Refer drawing no. no R2/E&amp;M/ 000031 and technical specification)</td>
<td>1 No.</td>
<td>6.6 kV switching station room</td>
</tr>
<tr>
<td>9</td>
<td>440 V Motor Control Centre (MCC - II) comprising of 1 no. of Incomer &amp; one no interconnecting ACB and required nos. of outgoing Feeders for supply of power to LT Motors of equipment like electric Hoists, tripper, pump house, BC2, belt weigher, Dust Suppression etc. (Refer drawing no. R2/E&amp;M/ 000031 and technical specification)</td>
<td>1 No.</td>
<td>Near bunker</td>
</tr>
<tr>
<td>10</td>
<td>440V Motor Control Centre (MCC III) at Silo MCC room comprising of 2 nos Incomer ACB &amp; one no.bus coupler and MCCBs and required nos. of outgoing Feeders for supply of power to LT Motors of equipment like Cooling water pump, Hydraulic power pack, Motorised Gates, Control room pressurisation &amp; Air conditioners, Welding sockets etc. (Refer drawing no R2/E&amp;M/ 000031 and technical specification)</td>
<td>1 No.</td>
<td>Silo MCC room</td>
</tr>
<tr>
<td>11</td>
<td>440V DOL Starters</td>
<td>Lot</td>
<td>Entire Plant</td>
</tr>
<tr>
<td>12</td>
<td>6.6 kV Capacitor Bank of 1272 kVAR capacity for improvement of Power Factor. (Refer drawing no. R2/E&amp;M/ 000031 and technical specification)</td>
<td>2 Nos.</td>
<td>6.6 kV switching station room</td>
</tr>
<tr>
<td>13</td>
<td>220V Lead Acid Battery complete with Battery Charging unit. (Refer technical specification)</td>
<td>2 Nos.</td>
<td>6.6 kV switching station room and Silo MCC Room</td>
</tr>
<tr>
<td>14</td>
<td>Control console for control of electrical drives supplied by 6.6kV switching station complete with microprocessor based PLC, audio-visual signalling, fault annunciation system, interlocking, printer, VDUs etc and dovetailing of sequence operation of BC1, BC3 &amp; BC4 with crusher, BC2 with SILO level indicator, coal sizer, plough feeder etc (Refer technical specification)</td>
<td>1 Set</td>
<td>6.6 kV switching station room and Silo MCC-III Room</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Equipment</td>
<td>Quantity</td>
<td>Location</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------------------------------------------------------</td>
<td>----------</td>
<td>----------------------------------------------</td>
</tr>
<tr>
<td>15</td>
<td>Control, automation, interlocks, Signalling and instrumentation of Rapid Loading system complete with microprocessor based PLC, audio-visual signalling, fault annunciation system, interlocking, printer, VDUs etc. (Refer technical specification)</td>
<td>1 Set</td>
<td>Silo MCC-III room</td>
</tr>
<tr>
<td>16</td>
<td>440/110V control transformer for AC control supply</td>
<td>4 nos.</td>
<td>2 no in 6.6 kV switching station room and 2 no. in Silo MCC-III Room</td>
</tr>
<tr>
<td>17</td>
<td>440/220V control transformer with necessary inverter for DC control supply</td>
<td>4 nos.</td>
<td>2 no in 6.6 kV switching station room and 2 no. in Silo MCC-III Room</td>
</tr>
<tr>
<td>18.1</td>
<td><strong>Cables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18.1.1</td>
<td><strong>Power cables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.6 kV grade, XLPE, single wire armoured aluminium conductor, FRLS cables of different sizes for supply of power to 6.6 kV panels, drives as per technical specification</td>
<td>lot</td>
<td>6.6 kV drives at different locations</td>
</tr>
<tr>
<td>18.1.2</td>
<td>1.1kV grade, PVC insulated, PVC sheathed single wire armoured aluminium conductor FRLS cables of different sizes as per technical specification</td>
<td>lot</td>
<td>LT drives of different locations of CHP</td>
</tr>
<tr>
<td>18.2</td>
<td><strong>Lighting cables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18.2.1</td>
<td>660/1100 V grade, PVC insulated, PVC sheathed, single wire armoured, Aluminium conductor, FRLS cables of different sizes as per technical specification</td>
<td>lot</td>
<td>Indoor and outdoor Illumination for CHP including Rapid Loading complex</td>
</tr>
<tr>
<td>18.3</td>
<td><strong>Control and Signalling cables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18.3.1</td>
<td>660/1100 V grade, single/multi core PVC insulated and sheathed, Copper conductor, FRLS, control and signalling cables of 2.5 sq. mm cross-section having different no. of cores as per technical specification</td>
<td>lot</td>
<td>Different control circuits of CHP.</td>
</tr>
<tr>
<td>19</td>
<td>Cable trays/cable racks (separate trays shall be used for power and control cables), cable trenches &amp; cable vaults etc as per technical specification</td>
<td>As per system requirement</td>
<td>Complete CHP</td>
</tr>
<tr>
<td>20</td>
<td><strong>Illumination system</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.1</td>
<td>415 V Main Lighting Distribution Board with incoming MCCB and outgoings MCBs as per technical specification.</td>
<td>2 nos.</td>
<td>1 each at 6.6kV switching station, MCC-III SILO control room</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Equipment</td>
<td>Quantity</td>
<td>Location</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------------------------------------------------------</td>
<td>----------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>20.1.2</td>
<td>Lighting Distribution Boards with incoming and outgoing MCCBs / MCBs as per technical specification</td>
<td>lot</td>
<td>Different location of plant as per requirement</td>
</tr>
<tr>
<td>21.</td>
<td><strong>Luminaires</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.1</td>
<td>Fluorescent/Compact Fluorescent fixtures (Industrial / decorative / dust tight type) as per requirement complete with control gears, accessories etc as per technical specification</td>
<td>lot</td>
<td>Different location of plant as per need</td>
</tr>
<tr>
<td>21.2</td>
<td>High pressure sodium vapour lamps (High-bay/Mid bay/Well glass / Street light/ Flood lights type) as per requirement complete with control gears, accessories etc as per technical specification</td>
<td>lot</td>
<td>Different location of plant as per need</td>
</tr>
<tr>
<td>21.3</td>
<td>Street lighting poles of suitable height embedded with conduit and bracket.</td>
<td>lot</td>
<td>Different location of plant as per need</td>
</tr>
<tr>
<td>21.4</td>
<td>Miscellaneous items like junction boxes complete with fuse, terminal block and other necessary accessories, cable glands, lugs, conduits, receptacles etc</td>
<td>lot</td>
<td>Different location of plant as per need</td>
</tr>
<tr>
<td>215</td>
<td>DG set of 400 kVA capacity for emergency lights</td>
<td>2 nos.</td>
<td>1 each at 6.6kV switching station &amp; Silo MCC room.</td>
</tr>
<tr>
<td>21.6</td>
<td>Digital clock based arrangement with all accessories and terminal for automatic switching ON/OFF of street lights</td>
<td>lot</td>
<td>6.6kV switching station</td>
</tr>
<tr>
<td>22</td>
<td><strong>Welding system</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22.1</td>
<td>Transformer welding set complete with cables and accessories to be housed in rooms (size 2 m x 3 m x 3 m each approx.)</td>
<td>6 nos.</td>
<td>Three different locations in the plant</td>
</tr>
<tr>
<td>22.2</td>
<td>Motor generator welding set</td>
<td>3 nos.</td>
<td>Three different locations in the plant</td>
</tr>
<tr>
<td>22.3</td>
<td>1.1kV grade, PVC insulated and sheathed single layer armoured, FRLS, Aluminium conductor cables for power supply to welding sockets.</td>
<td>lot</td>
<td>Entire plant</td>
</tr>
<tr>
<td>22.4</td>
<td>Dust proof plug sockets complete with switches, holder set etc throughout the plant.</td>
<td>lot</td>
<td>Different location of plant</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Equipment</td>
<td>Quantity</td>
<td>Location</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------------------------------------------------------</td>
<td>----------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>25</td>
<td>Earthing System</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25.1</td>
<td>Galvanised earthing strips / wires / conductors for main earthing grid,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>sub earthing grid of substations, building and structures, earthing of</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>light fittings, welding sockets, pull chord switches, belt sway switches,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>zero speed switches and various electrical equipment, Ground electrodes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>and earthing pits as per technical specification</td>
<td>lot</td>
<td>Complete Plant</td>
</tr>
<tr>
<td>25.2</td>
<td>Equipment and accessories for Lightning protection system for building</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>and structures having height of 10m and above with separate earth pits.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6.6kV switching station building, Silo and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>other structures in the CHP</td>
</tr>
<tr>
<td>26</td>
<td>Equipment and accessories for Pressurisation</td>
<td>3 sets</td>
<td>MCCs and control rooms at 6.6kV switching</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>station &amp; Silo</td>
</tr>
<tr>
<td>27</td>
<td>1.5 t Air conditioners</td>
<td></td>
<td>Engineer-in-Charge’s room - Maintenance-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>cum-Testing room - Control rooms</td>
</tr>
<tr>
<td>28</td>
<td>Miscellaneous items such as Local control, stations, testing equipment,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>electrical fire fighting equipment and other safety equipment as per</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>relevant Indian Standard &amp; Indian Electricity Rules. Furniture for control</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>rooms and substation buildings.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Exhaust and ceiling fans</td>
<td></td>
<td>6.6kV switching station and silo control room</td>
</tr>
<tr>
<td>30</td>
<td>Insulating mats as per IS for 6.6kV switching room, MCC rooms and control</td>
<td></td>
<td>6.6kV switching station- MCC rooms and control rooms</td>
</tr>
<tr>
<td>31</td>
<td>Voltage stabiliser for control circuit</td>
<td>As per requirement</td>
<td>6.6kV switching station- and control rooms</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Equipment</td>
<td>Quantity</td>
<td>Location</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------------------------------------------------------</td>
<td>----------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>32</td>
<td>Computer for the office of officer In-charge</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>i) Pentium-IV type PC, with CD drive and with laser printer complete with UPS of 30 minutes back-up.</td>
<td>lot</td>
<td>6.6kV switching station-and silo control room</td>
</tr>
<tr>
<td></td>
<td>ii) Laptop latest model, for re loading the soft-ware in PLC/PC</td>
<td>lot</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Any other equipment specifically not included but necessary for efficient operation of plant under this package</td>
<td>lot</td>
<td>Suitable locations</td>
</tr>
<tr>
<td>34</td>
<td><strong>Communication system</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34.1</td>
<td>Project administrative communication system complete with automatic dial type telephone sets at various location of Silo, MCC and control Room of sub-stations etc. including wiring of all sets up to a common junction box and connected to main auto exchange for external connection</td>
<td>lot</td>
<td>Suitable locations</td>
</tr>
<tr>
<td>34.2</td>
<td>Industrial type duplex loud hailing plant intercom system complete with cabling accessories etc. as per technical specification</td>
<td>lot</td>
<td>Suitable locations</td>
</tr>
<tr>
<td>35</td>
<td><strong>Miscellaneous Equipment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35.1</td>
<td>Aluminium portable telescopic ladders</td>
<td>1 No.</td>
<td>Suitable location</td>
</tr>
<tr>
<td>35.2</td>
<td>UPS 5 kVA</td>
<td>3 Nos.</td>
<td>6.6kV switching station-and silo control room</td>
</tr>
<tr>
<td>35.3</td>
<td>Fire Detection &amp; annunciation and fire fighting system</td>
<td>lot</td>
<td>Suitable locations</td>
</tr>
<tr>
<td>35.4</td>
<td>Testing equipment</td>
<td>lot</td>
<td></td>
</tr>
<tr>
<td>35.5</td>
<td>Mandatory Spares</td>
<td>lot</td>
<td></td>
</tr>
<tr>
<td>35.6</td>
<td>Recommended spares</td>
<td>lot</td>
<td></td>
</tr>
</tbody>
</table>
## B: LIST OF ELECTRICAL TESTING EQUIPMENT

<table>
<thead>
<tr>
<th>Sl.no.</th>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Transformer oil testing equipment</td>
<td>1 No.</td>
</tr>
<tr>
<td>2</td>
<td>Bridge megger</td>
<td>1 No.</td>
</tr>
<tr>
<td>3</td>
<td>Tong Tester - LT</td>
<td>3 Nos.</td>
</tr>
<tr>
<td>4</td>
<td>Relay testing equipment with electronic timer</td>
<td>1 No.</td>
</tr>
<tr>
<td>5</td>
<td>Testing board for different equipment with digital ammeters and voltmeters</td>
<td>1 No.</td>
</tr>
<tr>
<td>6</td>
<td>Earth tester</td>
<td>1 No.</td>
</tr>
<tr>
<td>7</td>
<td>AVO meter</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>8</td>
<td>500 GPH transformer oil purifier set with all</td>
<td>1 No.</td>
</tr>
<tr>
<td>9</td>
<td>Rubber insulating mat</td>
<td>As required</td>
</tr>
<tr>
<td>10</td>
<td>Lux meter</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>11</td>
<td>Tacho-meter</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>12</td>
<td>Tools and testing equipment for communication</td>
<td>As required</td>
</tr>
<tr>
<td>13</td>
<td>Cable fault detector digital type</td>
<td>1 No.</td>
</tr>
<tr>
<td>14</td>
<td>Contact pressure testing and adjusting for relays</td>
<td>3 Nos.</td>
</tr>
<tr>
<td>15</td>
<td>Tools and testing equipment for programmable logic controller system</td>
<td>As required</td>
</tr>
<tr>
<td>16</td>
<td>Soldering Iron kit</td>
<td>1 set</td>
</tr>
<tr>
<td>17</td>
<td>IC soldering kit</td>
<td>1 set</td>
</tr>
<tr>
<td>18</td>
<td>Oscillograph</td>
<td>1 set</td>
</tr>
<tr>
<td>19</td>
<td>On line IC Checker</td>
<td>1 set</td>
</tr>
<tr>
<td>20</td>
<td>Set of special tools including tools for overhauling and adjusting peripheral devices</td>
<td>As required</td>
</tr>
<tr>
<td>21</td>
<td>Rubber Hand gloves having insulation level 15 KV</td>
<td>8 pairs</td>
</tr>
<tr>
<td>22</td>
<td>Self propelled diesel operated mobile winch</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Self supported trolley mounted telescopic ladder</td>
<td>1 set</td>
</tr>
<tr>
<td>24</td>
<td>Crimping tool with dies, hydraulically operated</td>
<td>1 set</td>
</tr>
<tr>
<td>25</td>
<td>Vibration meter</td>
<td>1 No.</td>
</tr>
<tr>
<td>26</td>
<td>Sound level meter</td>
<td>1 No.</td>
</tr>
<tr>
<td>27</td>
<td>Portable temperature recorder with thermostat</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>28</td>
<td>Portable bearing condition monitor</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>29</td>
<td>Water distillation plant</td>
<td>1 No.</td>
</tr>
<tr>
<td>30</td>
<td>Any other standard testing equipment</td>
<td>As required</td>
</tr>
</tbody>
</table>

### Annexure-III.3
**Provision of Recommended Spare Parts**

Within the Contract Price, the Employer shall agree to purchase operational, maintenance and standby/contingency spare parts, consumable items, wear materials, maintenance tools and special tools (hereinafter collectively referred to as “Spare Parts” unless the context requires otherwise) in accordance with the Contractor's recommendations for twelve (12)
months from the date of issue of the Operational Acceptance Certificate. Similarly within the Contract Price, the Employer shall also agree to purchase consumable items (hereinafter referred to as “Consumables”) in accordance with the Contractor’s recommendations for twelve (12) months from the date of issue of the Operational Acceptance Certificate. In addition the Contractor shall provide Spare Parts and Consumables for Commissioning and Guarantee Tests as prescribed in the Contract Documents.

Consumables shall not include oils, lubricants, and fluids for the purposes of this Guarantee but the Contractor shall provide all necessary oils, lubricants and fluids for the purposes of Commissioning and Guarantee Tests in accordance with the Contract.

In the event that the Spare Parts and Consumables, as recommended by the Contractor, in any way fall short of actual requirements during the period for which they are said to be adequate, the Contractor shall provide such additional Spare Parts and Consumables as are necessary at the final destination. Such additional Spare Parts and Consumables shall be provided by the Contractor to the Employer free of all cost and shall be transported to Site by air freight internationally and by air, rail or fast road transport within India.

In the event that the Spare Parts and Consumables, as recommended by the Contractor, are in excess of actual requirements. The Employer may at its option:

(a) Retain such excess Spare Parts and Consumables, as in its discretion, it may be selected to do so;

(b) Require the Contractor to repossess or repatriate or otherwise dispose of such excess Spare Parts in exchange for payment to the Employer of the Contract Price of the Spare Parts and Consumables concerned: and

the Employer shall notify the Contractor, in writing of its requirements under this Clause within thirty (30) days of completion of the period referred to above.

In the event that operation of the Facilities is inhibited or frustrated as a direct result of lack of Spare Parts and Consumables then the period referred to above shall be extended by a period of not less than the period during which operation as aforesaid was inhibited or frustrated.

The Contractor shall not be liable for the supply of additional Spare Parts or Consumables, nor to extend the period referred to above, if and to the extent that, additional Spare Parts and Consumables are required by reason of unforeseen accidents, negligence or misuse on the part of the Employer.

The assessment of the Bidder of the spare parts requirements shall be based upon the maximum number of working hours per year as defined in the Technical Specifications.

The assessment of the Bidder of the spare parts requirements shall not consider the Mandatory Spare Parts called for by the Employer.
The Contractor may, subject to the prior written consent of the Project Manager, access the recommended spare parts for the purposes of effecting repairs/replacements to the Facilities under the Defect Liability of the Contractor provided always that any item of these Spare Parts and Consumables so used are replaced in the most expeditious manner by the Contractor and at no cost to the Employer. If the Contractor does not replace items in a timely manner then the Employer may procure such items independently of the Contractor and charge the Contractor with all costs associated therewith.

Annexure-III.3

LIST OF MANDATORY SPARE PART

A: MECHANICAL

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description of spare parts</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Gearboxes</td>
<td>1 of each of every type included in the Plant and Equipment</td>
</tr>
<tr>
<td>2.</td>
<td>Motors (LT and HT)</td>
<td>1 of each of every type for conveyor system, crushing system, Apron feeder, Plough feeder, RLS</td>
</tr>
<tr>
<td>3.</td>
<td>Couplings (Fluid and Other)</td>
<td>1 of each of every type included in the Plant and Equipment</td>
</tr>
<tr>
<td>4.</td>
<td>Pulleys</td>
<td>1 of each of every type included in the Plant and Equipment</td>
</tr>
<tr>
<td>5.</td>
<td>Cleaners</td>
<td>1 of each of every type included in the Plant and Equipment</td>
</tr>
<tr>
<td>6</td>
<td>Loadcells for pre weigh hopper</td>
<td>Oneset for each hopper</td>
</tr>
<tr>
<td>7</td>
<td>Bearings of gates</td>
<td>1 set for each type</td>
</tr>
<tr>
<td>8</td>
<td>Cylinders</td>
<td>1 set for each type</td>
</tr>
</tbody>
</table>
### LIST OF MANDATORY SPARE PART

#### B: ELECTRICAL

<table>
<thead>
<tr>
<th>Sl. no.</th>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>6.6 kV Motor</td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>One complete spare motor for each type and size</td>
<td>As required</td>
</tr>
<tr>
<td>2.0</td>
<td>Low Voltage Motor</td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>One complete spare motor for each type and size</td>
<td>As required</td>
</tr>
<tr>
<td>2.2</td>
<td>One set of bearing for each type of motor</td>
<td>As required</td>
</tr>
<tr>
<td>3.0</td>
<td>HT and LT switch Gear</td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>Vacuum interrupter</td>
<td>3 sets</td>
</tr>
<tr>
<td>3.2</td>
<td>Spring charging motor for VCB</td>
<td>1 set</td>
</tr>
<tr>
<td>3.3</td>
<td>Closing coil for VCB</td>
<td>2 sets</td>
</tr>
<tr>
<td>3.4</td>
<td>Breaker control switch</td>
<td>2 set</td>
</tr>
<tr>
<td>Sl. no.</td>
<td>Item</td>
<td>Quantity</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>3.5</td>
<td>Tripping coil for VCB</td>
<td>2 sets</td>
</tr>
<tr>
<td>3.6</td>
<td>Ammeter selector switch</td>
<td>2 sets</td>
</tr>
<tr>
<td>3.7</td>
<td>Voltmeter selector switch</td>
<td>2 sets</td>
</tr>
<tr>
<td>3.8</td>
<td>Over current relay</td>
<td>2 sets</td>
</tr>
<tr>
<td>3.9</td>
<td>Directional over current relay</td>
<td>2 sets</td>
</tr>
<tr>
<td>3.10</td>
<td>Under voltage relay</td>
<td>1 set</td>
</tr>
<tr>
<td>3.11</td>
<td>Over voltage relay</td>
<td>1 set</td>
</tr>
<tr>
<td>3.12</td>
<td>Pilot lamp (Red)</td>
<td>5 sets</td>
</tr>
<tr>
<td>3.13</td>
<td>Pilot lamp (Green)</td>
<td>5 sets</td>
</tr>
<tr>
<td>3.14</td>
<td>Pilot lamp (White)</td>
<td>5 sets</td>
</tr>
<tr>
<td>3.15</td>
<td>Pilot lamp (Orange)</td>
<td>5 sets</td>
</tr>
<tr>
<td>3.16</td>
<td>Control fuse 2A, 4A, 10A</td>
<td>25 sets</td>
</tr>
<tr>
<td>3.17</td>
<td>CTT</td>
<td>2 sets</td>
</tr>
<tr>
<td>3.18</td>
<td>PTT</td>
<td>2 sets</td>
</tr>
<tr>
<td>3.19</td>
<td>Fuse for vacuum contactor</td>
<td>3 sets</td>
</tr>
<tr>
<td>3.20</td>
<td>Auxiliary relay</td>
<td>5 sets</td>
</tr>
<tr>
<td>3.21</td>
<td>7.2 kV, 630A, 25 kA Vacuum circuit breaker</td>
<td>1 set</td>
</tr>
<tr>
<td>3.22</td>
<td>6.6 KV, 200A, Vacuum contactor</td>
<td>1 set</td>
</tr>
<tr>
<td>4.0</td>
<td>Transformer</td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>H.T. Bushing each type</td>
<td>2 sets</td>
</tr>
<tr>
<td>4.2</td>
<td>L.T. Bushing</td>
<td>2 sets</td>
</tr>
<tr>
<td>4.3</td>
<td>Silica gel</td>
<td>2 sets</td>
</tr>
<tr>
<td>4.4</td>
<td>All sizes of gasket</td>
<td>2 sets</td>
</tr>
<tr>
<td>5.0</td>
<td>Illumination</td>
<td></td>
</tr>
<tr>
<td>5.1</td>
<td>40 W Fluorescent lamp</td>
<td>50 Nos.</td>
</tr>
<tr>
<td>5.2</td>
<td>HPSV lamp of each size</td>
<td>10 each</td>
</tr>
</tbody>
</table>
# LIST OF TOOLS AND TACKLES

<table>
<thead>
<tr>
<th>No.</th>
<th>Nomenclature</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Hydraulic jack – 100 Te</td>
<td>1 No.</td>
</tr>
<tr>
<td>2.</td>
<td>Pull lift M/c – 1.5t</td>
<td>1 No.</td>
</tr>
<tr>
<td>3.</td>
<td>Pull lift M/c – 3.5t</td>
<td>1 No.</td>
</tr>
<tr>
<td>4.</td>
<td>Pull lift M/c – 5t</td>
<td>1 No.</td>
</tr>
<tr>
<td>5.</td>
<td>Drill Electric (1-1/2&quot;)</td>
<td>1 No.</td>
</tr>
<tr>
<td>6.</td>
<td>Aluminium ladder (3M)</td>
<td>1 No.</td>
</tr>
<tr>
<td>7.</td>
<td>Telescopic Aluminium ladder (7M)</td>
<td>1 No.</td>
</tr>
<tr>
<td>8.</td>
<td>Marking punches</td>
<td>1 No.</td>
</tr>
<tr>
<td>9.</td>
<td>Vice Grip</td>
<td>1 No.</td>
</tr>
<tr>
<td>10.</td>
<td>Three legged tripod (fixed height)</td>
<td>1 No.</td>
</tr>
<tr>
<td>11.</td>
<td>Hydraulic cable jointing kit suitable up to 240 sq. mm cable size</td>
<td>1 set</td>
</tr>
<tr>
<td>12.</td>
<td>Spirit level</td>
<td>1 No.</td>
</tr>
<tr>
<td>13.</td>
<td>Feeler gauges</td>
<td>2 sets</td>
</tr>
<tr>
<td>14.</td>
<td>Scribers</td>
<td>1 No.</td>
</tr>
<tr>
<td>15.</td>
<td>Dial gauges (alignment)</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>16.</td>
<td>Steel tape (15 M)</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>17.</td>
<td>Vernier calliper (Internal and External)</td>
<td>2 sets each</td>
</tr>
<tr>
<td>18.</td>
<td>Steel scales</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>20.</td>
<td>Tri square</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>21.</td>
<td>Plumb bobs</td>
<td>1 No.</td>
</tr>
<tr>
<td>22.</td>
<td>Bucket volume grease gun Tecalamite make (30L)</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>23.</td>
<td>Oil can (1/2 litre)</td>
<td>4 Nos.</td>
</tr>
<tr>
<td>24.</td>
<td>Files 10&quot;, flat rounded half rounded basted round files etc.</td>
<td>4 Nos. each</td>
</tr>
<tr>
<td>25.</td>
<td>Micro metre (Inside, outside)</td>
<td>2 each</td>
</tr>
<tr>
<td>26.</td>
<td>Torque wrenches (2&quot;, 4&quot;, 8&quot;) of suitable torque capacity</td>
<td>1 No. each</td>
</tr>
<tr>
<td>27.</td>
<td>Standard ring spanners (up to 30 mm)</td>
<td>4 sets</td>
</tr>
<tr>
<td>No.</td>
<td>Nomenclature</td>
<td>Quantity</td>
</tr>
<tr>
<td>-----</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>28.</td>
<td>Standard DE spanners (up to 30 mm)</td>
<td>4 sets</td>
</tr>
<tr>
<td>29.</td>
<td>Tabular box spanners</td>
<td>4 sets</td>
</tr>
<tr>
<td>30.</td>
<td>Socket box spanners</td>
<td>4 sets</td>
</tr>
<tr>
<td>31.</td>
<td>Circlip extractors, bearing extractors and oil seal extractors</td>
<td>One set</td>
</tr>
<tr>
<td>32.</td>
<td>Belt puller (Motorised winch type with 200mm rope capacity 1.5 Te)</td>
<td>1 No.</td>
</tr>
<tr>
<td>33.</td>
<td>1.5 Te capacity rope pull tackle manual without</td>
<td>1 No.</td>
</tr>
<tr>
<td>34.</td>
<td>Four inch dia wheel, AC motor driven portable grinding machine and flexible grinder</td>
<td>1 set</td>
</tr>
<tr>
<td>35.</td>
<td>Vacuum cleaner for control room, sub-station and MCC rooms suitable for system requirement</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>36.</td>
<td>Any other type of spanners/tools required for operation and maintenance of equipment as per manufacturer’s recommendations.</td>
<td>1 set each</td>
</tr>
<tr>
<td>37.</td>
<td>Engineers level gauge</td>
<td>1 No.</td>
</tr>
<tr>
<td>38.</td>
<td>Cabinet 2’ x 4’ with 2 Nos. carrying trays</td>
<td>1 set</td>
</tr>
<tr>
<td>39.</td>
<td>Bearing puller (SKF make) for up to 250 mm dia</td>
<td>1 set</td>
</tr>
<tr>
<td>40.</td>
<td>Bearing puller 3 legged</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>41.</td>
<td>Sound level meter</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>42.</td>
<td>Vibration meter</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>43.</td>
<td>Temperature monitor meter (sec.)</td>
<td></td>
</tr>
<tr>
<td>44.</td>
<td>High potential test kit</td>
<td>1 No.</td>
</tr>
<tr>
<td>45.</td>
<td>Adjustable wrench 8”</td>
<td>2 sets</td>
</tr>
<tr>
<td>46.</td>
<td>Wire rope slings with eye bolt and D-shackles for 1 ton, 5 ton, 10 ton, 50 ton and 100 T lifting capacity</td>
<td>2 sets each up to 10 Te &amp; 1 set each for 50 Te &amp; 100 Te</td>
</tr>
<tr>
<td>47.</td>
<td>Adjustable wrench 10”</td>
<td>2 sets</td>
</tr>
<tr>
<td>48.</td>
<td>Adjustable wrench 12”</td>
<td>2 sets</td>
</tr>
<tr>
<td>49.</td>
<td>Slip joint pliers 6”</td>
<td>3 sets</td>
</tr>
<tr>
<td>50.</td>
<td>Slip joint pliers 8”</td>
<td>3 sets</td>
</tr>
<tr>
<td>51.</td>
<td>Rib glove pliers 10”</td>
<td>3 sets</td>
</tr>
<tr>
<td>52.</td>
<td>Diagonal pliers 6”</td>
<td>3 sets</td>
</tr>
<tr>
<td>53.</td>
<td>Long nose pliers 6”</td>
<td>3 sets</td>
</tr>
<tr>
<td>54.</td>
<td>Chain nose pliers 8”</td>
<td>3 sets</td>
</tr>
<tr>
<td>55.</td>
<td>Side cutting pliers 8”</td>
<td>1 set</td>
</tr>
<tr>
<td>56.</td>
<td>Vice Slip joint pliers 6”</td>
<td>2 sets</td>
</tr>
<tr>
<td>57.</td>
<td>HD pipe wrench 10”/14”</td>
<td>2 sets</td>
</tr>
<tr>
<td>No.</td>
<td>Nomenclature</td>
<td>Quantity</td>
</tr>
<tr>
<td>------</td>
<td>------------------------------------------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>59</td>
<td>Extension bar 5&quot;, 6&quot;</td>
<td>2 sets</td>
</tr>
<tr>
<td>60</td>
<td>Speeder handle</td>
<td>2 sets</td>
</tr>
<tr>
<td>61</td>
<td>Ratchet spanner</td>
<td>3 sets</td>
</tr>
<tr>
<td>62</td>
<td>Universal joint</td>
<td>2 sets</td>
</tr>
<tr>
<td>63</td>
<td>Sliding &quot;T&quot; handle</td>
<td>2 sets</td>
</tr>
<tr>
<td>64</td>
<td>Deep socket</td>
<td>2 sets</td>
</tr>
<tr>
<td>65</td>
<td>5 pcs screw drive set (-)</td>
<td>4 sets</td>
</tr>
<tr>
<td>66</td>
<td>5 pcs screw drive set (+)</td>
<td>4 sets</td>
</tr>
<tr>
<td>67</td>
<td>Plastic hammer, 1 kg</td>
<td>3 sets</td>
</tr>
<tr>
<td>68</td>
<td>Ball point hammer, 500 g</td>
<td>3 sets</td>
</tr>
<tr>
<td>69</td>
<td>Wire tripper 4&quot;</td>
<td>3 sets</td>
</tr>
<tr>
<td>70</td>
<td>Steel compass 300 A</td>
<td>2 sets</td>
</tr>
<tr>
<td>71</td>
<td>Spring divider 300 A</td>
<td>2 sets</td>
</tr>
<tr>
<td>72</td>
<td>Tool box with set of spanner</td>
<td>3 sets</td>
</tr>
<tr>
<td>73</td>
<td>Straight edge 3 m length</td>
<td>3 sets</td>
</tr>
<tr>
<td>74</td>
<td>Motorised oil filling pump and motor set (As per system requirement)</td>
<td>1 set</td>
</tr>
<tr>
<td>75</td>
<td>Motorised blower 220 V</td>
<td>3 Nos.</td>
</tr>
<tr>
<td>76</td>
<td>Stop watch</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>77</td>
<td>Portable air compressor</td>
<td>As per Clause 8.2</td>
</tr>
<tr>
<td>78</td>
<td>Pipe wrench (chain type) for 4&quot; and 6&quot; pipe</td>
<td>2 each</td>
</tr>
<tr>
<td>79</td>
<td>Passimeter (for measuring inside bore)</td>
<td>1 set</td>
</tr>
<tr>
<td>80</td>
<td>Sledge hammers</td>
<td>3 Nos.</td>
</tr>
<tr>
<td>81</td>
<td>Pulley block for manila ropes</td>
<td>3 Nos.</td>
</tr>
<tr>
<td>82</td>
<td>Pneumatic wrench</td>
<td>1 No.</td>
</tr>
<tr>
<td>83</td>
<td>Automatic filling / emptying system for lubrication in crusher lubrication tank, gearboxes etc.</td>
<td>1 No.</td>
</tr>
<tr>
<td>84</td>
<td>Spot vulcaniser (12&quot;)</td>
<td>1 No.</td>
</tr>
<tr>
<td>85</td>
<td>Motorised belt reeling drum for belt laying/replacement</td>
<td>3 No.</td>
</tr>
</tbody>
</table>
## Schedule of Conveyors

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Particulars</th>
<th>1C</th>
<th>2C</th>
<th>3C&amp;4C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Length (Horizontal) (m)</td>
<td>165.00</td>
<td>110.00</td>
<td>485.00</td>
</tr>
<tr>
<td>2</td>
<td>Belt Width, (mm)</td>
<td>1400</td>
<td>1400</td>
<td>1400</td>
</tr>
<tr>
<td>3</td>
<td>Belt Speed, m/sec</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>4</td>
<td>Capacity (Rated), TPH</td>
<td>1200</td>
<td>1200</td>
<td>1200</td>
</tr>
<tr>
<td>5</td>
<td>Lifts, m</td>
<td>30.00</td>
<td>5.00</td>
<td>58.00</td>
</tr>
<tr>
<td>6</td>
<td>Quantity</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Conveyor Drive Power, kW</td>
<td>210</td>
<td>90+22(for tripper)</td>
<td>2x220</td>
</tr>
<tr>
<td>8</td>
<td>Type of Drive</td>
<td>Snub</td>
<td>Snub</td>
<td>Dual</td>
</tr>
<tr>
<td>9</td>
<td>Mat. to be carried</td>
<td>Coal</td>
<td>Coal</td>
<td>Coal</td>
</tr>
<tr>
<td>10</td>
<td>Bulk density of material, Te/cum</td>
<td>0.8-1.15</td>
<td>0.8-1.15</td>
<td>0.8-1.15</td>
</tr>
<tr>
<td>11</td>
<td>Trough Angle in deg</td>
<td>35</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>12</td>
<td>Lump size (mm)</td>
<td>(- )1200</td>
<td>(- ) 1200</td>
<td>(- )1200</td>
</tr>
<tr>
<td>13</td>
<td>No of loading points</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>Type of take-up</td>
<td>screw</td>
<td>screw</td>
<td>gravity</td>
</tr>
<tr>
<td>15</td>
<td>Anti-roll back devices</td>
<td>Required</td>
<td>Required</td>
<td>Required</td>
</tr>
<tr>
<td>16</td>
<td>Type of coupling</td>
<td>Fluid /Gear coupling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Drum diameter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>Drive/Head pulleys(mm)</td>
<td>800</td>
<td>800</td>
<td>1000</td>
</tr>
<tr>
<td>B</td>
<td>Snub, Tail pulleys, take up (mm)</td>
<td>630</td>
<td>630</td>
<td>800</td>
</tr>
<tr>
<td>C</td>
<td>Bend pulley (mm)</td>
<td>500</td>
<td>630</td>
<td>630</td>
</tr>
</tbody>
</table>

**Note:**

1) Conveyor length, lift to be checked and may undergo changes during detail design stage.
2) Drive powers and pulley diameters given are minimum. If required, these may be increased during detail design stage.
3) Conveyor calculation as per Indian standard (IS 11592) to be followed.
4) Allowable maximum inclination for all conveyors shall be 1:5

**Note:**

**Note:**

**Note:**

**Note:**

**Note:**

**Note:**
## Schedule of Belting

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Belt width (mm)</th>
<th>Type of Drive</th>
<th>Type of Belting</th>
<th>Min. Working Tension (kN/M)</th>
<th>Top Cover Thickness (mm)</th>
<th>Bottom Cover Thickness (mm)</th>
<th>Type of Joint</th>
<th>Cover Grade</th>
<th>Quantity (m) (Approx)</th>
<th>Conveyor Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1400</td>
<td>Snub</td>
<td>Nilon/Nilon</td>
<td>110</td>
<td>5</td>
<td>3</td>
<td>Vulcanised</td>
<td>FRAS</td>
<td>2600</td>
<td>C1, C2, C3 &amp; C4</td>
</tr>
</tbody>
</table>

**Note:**

1) Ratings/length given are minimum. If required, these may be increased during detail design stage.
2) The minimum belt in the horizontal loop take-up shall be sufficient enough for making three additional joints.
3) The Minimum yield strength of N-N belt shall be 110 kN/m.
4) All the Conveyor belts shall be fire resistant type.
# LOCATION FOR INSTALLATION OF ELECTRIC HOIST AND CHAIN PULLEY BLOCKS

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Location</th>
<th>Electric Hoist</th>
<th>Chain Pulley Block</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Receiving Pit</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Single roll crusher &amp; coal sizer Apron feeder</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Receiving Pit</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Single roll crusher &amp; coal sizer Apron feeder</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>TH-1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>TH-2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Above bunker for tripper</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Drive/Take up of Conveyor C1 &amp; C2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Drive/take up of Conveyor C3 &amp; C4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>Silo top</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Sampler house</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>11</strong></td>
<td><strong>7</strong></td>
</tr>
</tbody>
</table>

Note: The capacity of Electric Hoist/ Chain Pulley Block shall be 25% more than the heaviest assembly/ component to be lifted. At the same time, the rating of Electric Hoist/ Chain Pulley Block shall be standardized to minimize inventory for maintenance and interchangeability.
### APPROVED VENDORS LIST FOR MECHANICAL EQUIPMENT

[All the equipment (mechanical/ electrical) and accessories shall be from the list given below. If a prospective bidder wants to propose the names of any additional vendors, he may do so during the pre-bid meeting with full credentials of the proposed vendors. Employer will consider such requests on merit and intimate the names of additional vendors, if any, in the pre-bid meeting minutes. No further addition of vendors shall be permitted.]

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>ITEM DESCRIPTION</th>
<th>NAME OF APPROVED MANUFACTURERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CONVEYOR IDLERS</td>
<td>ELECON / TRF/ KALI / MBE / KRUPP INDUSTRIES / / HINDUSTAN UDYOG LTD./ BENGAL TOOLS LTD.</td>
</tr>
<tr>
<td>2</td>
<td>CONVEYOR PULLEYS</td>
<td>ELECON / TRF / KALI/ MBE / KRUPP INDUSTRIES/ / HINDUSTAN UDYOG LTD./ BENGAL TOOLS LTD./</td>
</tr>
<tr>
<td>3</td>
<td>ACTUATORS</td>
<td>TECHNO-MECH. ENGINEER/ ACTUATORS INDIA / INDIAN ENGG. WORKS</td>
</tr>
<tr>
<td>4</td>
<td>GEAR BOX</td>
<td>ELECON / GREAVES COTTON / FLENDER/ GEARS INDIA / ALLEN BERRY / MACNEILL GEARS / DAVID BROWN / ALLEN RANK / RADIONELECON / NAW / FENNER / HI- CLIEF/ WELLMAN-BIBBY / ESBIHI- FLEX PVT. LTD.</td>
</tr>
<tr>
<td>5</td>
<td>COUPLING (FLEXIBLE/GEARED)</td>
<td>ELECON/NAW/FENNER/HI:CLIEF/WELLMAN-BIBBY/ESBIHI-FLEX PVT.</td>
</tr>
<tr>
<td>6</td>
<td>FLUID COUPLING</td>
<td>VOITH / PEMBRIL ELECON / FLUID DRIVE / FLUIDOMAT/ :ELECON / MBE / TRF / L&amp;T / APHMEL</td>
</tr>
<tr>
<td>7</td>
<td>BELT CONVEYOR</td>
<td>ELECON/MBE/TRF/L&amp;T/APHMEL/CRUPP INDUSTRIES/HINDUSTHAN UDYOG LIMITED/BENGAL TOOLS LTD/SANDVIK ASIA LTD</td>
</tr>
<tr>
<td>8</td>
<td>BELTING</td>
<td>MRF / NIRLON / PHOENIX YULE / NORTHLAND RUBBER MILLS / HILTON / ORIENT RUBBER / FORECH / HINDUSTAN RUBBER</td>
</tr>
<tr>
<td>9</td>
<td>STEEL CORD BELTING</td>
<td>PHOENIX YULE / BANDO, JAPAN / CLOUTH, GERMANY / IMAS, GERMANY / DUNLOP/ MARUBENI, JAPAN / SIG, ITALY</td>
</tr>
<tr>
<td>10</td>
<td>APRON FEEDER</td>
<td>SAYAJEE / L&amp;T / HEC / MBE /ELECON/TRF/ KRUPP</td>
</tr>
<tr>
<td>11</td>
<td>ROTARY PLOUGH FEEDER</td>
<td>LOUISE INDIA/TRF/KRUPP INDUSTRIES/ELECON/L&amp;T</td>
</tr>
<tr>
<td>SL. NO.</td>
<td>ITEM DESCRIPTION</td>
<td>NAME OF APPROVED MANUFACTURERS</td>
</tr>
<tr>
<td>--------</td>
<td>------------------------</td>
<td>---------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>12</td>
<td>GYRATORY CRUSHER</td>
<td>FFE (INDIA) LTD. / HEC / KRUPP, GERMANY / METSO, USA / ROXON, FINLAND / KOBE STEEL, JAPAN / UNITED HEAVY MACHINERY (URALMASH IZHORE GROUP), RUSSIA/</td>
</tr>
<tr>
<td>13</td>
<td>SIZERS</td>
<td>SANDVIK ASIA LTD. MMD / FFE / STAMLER OLDENBURG (UK) / HYSSUNKRUPP / DBTMINERALMINERALPROCESSI NG Gmbh, GERMANY</td>
</tr>
<tr>
<td>14</td>
<td>RAPID LOADING OUTFITS</td>
<td>STRATEGIC WEIGHING SYSTEMS / MERIT ENGG / KANAWHA, SCALES AND SYSTEM INC, USA / RAMSEY</td>
</tr>
<tr>
<td>15</td>
<td>HYDRAULIC ROCK BREAKER</td>
<td>TELEDYN / L&amp;T / INGRESOL-RAND / VIPER INTERNATIONAL, U.K. / KRUPP GERMANY / SANDVIK ASIA LTD.</td>
</tr>
<tr>
<td>16</td>
<td>BELT WEIGHER</td>
<td>JHONSON &amp; NICHOLSON / POWER BUILD / AUTO MEASUREMATIC / GILLANDERS / KIS TELEMORSE</td>
</tr>
<tr>
<td>17</td>
<td>CHUTE LINER</td>
<td>TEGA / KAVERI / HILTON / DEVI-RUBBER / WEAR RESISTANT TECHNOLOGIST</td>
</tr>
<tr>
<td>18</td>
<td>CHAIN PULLEY BLOCK</td>
<td>INDEF / TRACTEL TIRFOR / GREAVES COTTON / BATLIBOI / TURBO FURGUSON / ELEMECH HOIST / GRIP ENGINEERS / REVA ENGG. / KANUBHAI / SUREKA / ARMSSEL</td>
</tr>
<tr>
<td>19</td>
<td>MOTORISED FLAP GATE</td>
<td>TECHNO-MECH / ACTUATORS INDIA / PRECISION / MERIT ENGG.</td>
</tr>
<tr>
<td>20</td>
<td>PUMPS</td>
<td>MATHER &amp; PLATT / KIRLOSKAR / GREAVES COTTON / JYOTI / MAMC / HUMBOLDG WEDAG / DORR OLIVER / HYD. IND. / KSB / BEACONWEIR</td>
</tr>
<tr>
<td>21</td>
<td>BUNKER LEVEL INDICATOR</td>
<td>UPTRON / ENDRESS &amp; HOUSER / NIVO CONTROLS / AUTO MEASUREMATIC / MONITOR CONTROLS / EPI INSTRUMENTS / HEIN-LEHMANN / EIP BULK CONTROLS / KISTLERMORSE</td>
</tr>
<tr>
<td>22</td>
<td>ELECTRIC HOIST</td>
<td>HOIST-O-MECH / GREAVES COTTON / ELEMECH HOIST / POWER BUILD / KANUBHAI / INDEF / BATLIBOI / BRADY / TRACTEL TIRFOR / HITECH / TURBO-FURGUSON / GRIP ENGG. / SWIFT (GREAVES) / KM ENGG. / SUREKA</td>
</tr>
<tr>
<td>23</td>
<td>FIRE FIGHTING SYSTEM</td>
<td>MINI-MAX / THERMAX / VIJAY / F. HARLEY / APC / TECHNO FAB / STEELAGE / TECHNO INDIA / PROJECTS AND CONTROL</td>
</tr>
<tr>
<td>SL. NO.</td>
<td>ITEM DESCRIPTION</td>
<td>NAME OF APPROVED MANUFACTURERS</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>25</td>
<td>VENTILATION SYSTEM</td>
<td>FLAKT INDIA/ C.DOCTOR &amp; CO./ MAMC/ VOLTAS / BATLIBOI / ABB INDIA / ANDREW YULE/ DUST VAN/ PROJECTS AND CONTROL/ INDVENT FANS/ ARGOSY INCORPORATED / ALSTOM/ APC/ NELSON.</td>
</tr>
<tr>
<td>26</td>
<td>DUST SUPPRESSION</td>
<td>BATLIBOI/ F. HARLEY/ GEC/ VENDON INDIA LTD. / THERMAX / ANDREW YULE/APC/ PROJECTS AND CONTROL/ KAVERI</td>
</tr>
<tr>
<td>27</td>
<td>DUST EXTRACTION</td>
<td>FLAKT INDIA / ANDREW YULE / GEC / THERMAX / DUVANT/ ABB INDIA / DUST VAN/ PROJECTS AND CONTROL/ INDVENT FANS / ARGOSY INCORPORATED / ALSTOM/ APC / NELSON</td>
</tr>
<tr>
<td>28</td>
<td>FREIGHT-CUM-PASSENGER LIFT</td>
<td>OTIS / ECE / MITSHUBISHI, JAPAN / KONE</td>
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<td>29</td>
<td>BELT VULCANISER</td>
<td>NILOS / SHAW ALMEX PVT LTD.</td>
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<tr>
<td>30</td>
<td>AIR BLASTER</td>
<td>TECHNOFAB/ LINEMANN HALFLO, U.K. / DSI/ TEGA / MM FABRICATOR</td>
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<tr>
<td>31</td>
<td>SAMPLING SYSTEM</td>
<td>RAMSEY/ ADVANCE SYSTEM / EASTMAN CRUSHER</td>
</tr>
<tr>
<td>32</td>
<td>METAL DETECTOR</td>
<td>POWER BUILD/ ELECTROMAG/ MAGNET INDIA/ M.R.EQUIPMENT/ AUTOMATIC CONTROLS/ ERITZ, UK / ELECTRO ZAVED/ KRUPP, GERMANY/ ELECTRO MAGNETIC INDUSTRIES/ MAGNETIC CORPORATION OF INDIA / MAGNET INDUSTRIES(CAL) PVT. LTD.</td>
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<td>33</td>
<td>CROSS BELT MAGNETIC SEPARATOR</td>
<td>PBL/ ELECTROMAG/ STEARNS MAGNETIC/ MAGNET INDIA / ERITZ, UK / ELECTRO ZAVED/ KRUPP, GERMANY/ ELECTRO MAGNETIC INDUSTRIES/ MAGNETIC CORPORATION OF INDIA / MAGNET INDUSTRIES(CAL) PVT. LTD.</td>
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<td>34</td>
<td>OVER HEAD SUSPENDED TRAMP IRON MAGNET</td>
<td>PBL/ ELECTROMAG/ STEARNS MAGNETIC/ MAGNET INDIA / ERITZ, UK / ELECTRO ZAVED/ KRUPP, GERMANY/ ELECTRO MAGNETIC INDUSTRIES/ MAGNETIC CORPORATION OF INDIA / MAGNET INDUSTRIES(CAL) PVT. LTD.</td>
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<td>1</td>
<td>MOTOR (L.T.)</td>
<td>KIRLOSKAR/ BHEL/ SIEMENS/ ATHONELECTRIC MOTORS/ JYOTI/ NGEF/ ABB/ CROMPTON GREAVES/ BHARAT BIJLEE/ INTEGRATED ELECTRIC COMPANY LTD/ LAXMI HYDRAULICS PVT LTD.</td>
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<td>2</td>
<td>MOTOR (H.T.)</td>
<td>KIRLOSKAR/ BHEL/ SIEMENS/ MARATHON ELECTRIC MOTORS/ JYOTI/ NGEF/ ABB/ CROMPTON GREAVES/ BHARAT BIJLEE/ INTEGRATED ELECTRIC COMPANY LTD. / LAXMI HYDRAULICS PVT LTD</td>
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<td>3</td>
<td>FLP MOTORS</td>
<td>KIRLOSKAR/ BHEL/ BHARAT BIJLEE/ CROMPTON GREAVES/ MATHER &amp; GREAVES/ LAXMI HYDRAULICS PVT LTD</td>
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<td>4</td>
<td>POWER TRANSFORMER</td>
<td>KIRLOSKAR/ BHEL/ BHARAT BIJLEE/ GE INDUSTRIAL/ CROMPTON GREAVES/ ANDREW YULE/ SIEMENS/VOLTAS/ ABB/ NGEF</td>
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<td>5</td>
<td>LIGHTING TRANSFORMER</td>
<td>KIRLOSKAR/ BHEL/ BHARAT BIJLEE/ GE INDUSTRIAL/ CROMPTON GREAVES/ ANDREW YULE/ SIEMENS/VOLTAS/ ABB/ NGEF/ L &amp;T / POWER MASTER ELECTRICAL PVT. LTD</td>
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<td>6</td>
<td>CONTROL TRANSFORMER</td>
<td>L&amp;T/ SIEMENS/ JYOTI/ GE BHARAT INDUSTRIAL/ NGEF/ KIRLOSKAR/ CUTLER HAMMER</td>
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<tr>
<td>7</td>
<td>VACCUM CURCUIT BREAKER/ 6.6/ 11 kV SWITCHGEAR</td>
<td>KIRLOSKAR SYSTEMS/ BHEL/ JYOTI/ MEI/ SIEMENS/ ABB/ GE INDUSTRIAL/ ALIND /NGEF/ ANDREW YULE/ ASEA / SOUTHERN SWITCHGEAR (SSG)/ ELECTRO TEKNICA/ MEDITRON /SAIT Mine Line/Biecco Lawrie/ APE POWER PVT.</td>
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<tr>
<td>8</td>
<td>VACCUM CONTACTOR</td>
<td>GE INDUSTRIAL / JYOTI/ UNIVERSAL ELECTRICAL/ BHEL/ ANDREW YULE/ SIEMENS/ CROMPTON GREAVES</td>
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<tr>
<td>9</td>
<td>LT SWITCH BOARD PANEL/ MOTOR CONTROL CENTRE/ AIR CIRCUIT BREAKER / MCCB / MCB / RCCB</td>
<td>NGEF/ L&amp;T/ ANDREW YULE/ GE INDUSTRIAL / JYOTI/ SIEMENS/ BHARATIA INDUSTRIES LTD./ ABB/ EASUN ENGG/ CROMPTON GREAVES/ KIRLOSKAR SYSTEMS / SCHNEIDER/ CONTROL &amp; SWITCHGEAR COMPANY/ MINILEC(INdia) PVT LTD/ STANDARD ELECTRICALS LTD/ JOLLY ENGG./ TRANSIGETZ</td>
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<td>10</td>
<td>P.F.CORRECTION EQUIPMENT</td>
<td>ABB/ MADHAV CAPACITOR/ GE INDUSTRIAL / VOLTAS/ YESHA/ KHATAU JUNKER/ BHEL/ UNISTAR/ NGEF/ BHARATIA INDUSTRIES LTD./ EPCOS.</td>
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<td>11</td>
<td>POWER CABLES &amp; CONDUCTORS</td>
<td>CABLE CORPORATION/ FORT GLOSTER/ UNIVERSAL CABLES/ NICCO/ PREMIER CABLES/ HINDUSTAN CABLES/ INCAB / ASEA / HAVELLS / RADIANT/ LASER CABLES/ SKYTONE/ LUMINO.</td>
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<td>12</td>
<td>CONTROL CABLES</td>
<td>CABLE CORPORATION/ FORT GLOSTER/ NICCO/ ASEAN/ UNISTAR/ HINDUSTAN CABLES/ K.D.K./ RAJNIGANDHA CABLES/ HAVELLS/ RADIANT/ LASER CABLES/ SKYTONE.</td>
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<tr>
<td>13</td>
<td>COMMUNICATION CABLES</td>
<td>HINDUSTAN CABLES/ DELTRON/ TOSHNIWAL/ INCAB / VINDHYA TELELINK LTD.</td>
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<td>Name of Approved Manufacturers</td>
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<td>14</td>
<td>HT TRAILING CABLES</td>
<td>UNISTAR/ INCAB</td>
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<td>15</td>
<td>COMMUNICATION SYSTEM/ EQUIPMENT</td>
<td>ITI/ PHILIPS / MOTWANE/ TATA TELECOM / UPTRON/ GE INDUSTRIAL / ECI/ CROMPTON GREAVES</td>
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<tr>
<td>16</td>
<td>LIGHT FITTINGS</td>
<td>PHILIPS/ CROMPTONS/ GE INDUSTRIAL / BAJAJ/ ECE / GLOLITE /ANCHOR</td>
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<td>18</td>
<td>PLC</td>
<td>L&amp;T/ SIEMENS/ ALLEN BRADLEY/ KELTRON/ UPTRON/ TTS SYSTEMATIC PVT. LTD./ ABB/ MITSUBISI/ SCHNEIDER/ GE FANUC/ BHARATIA INDUSTRIES LTD/ MINILEC(INDIA) PVT LTD./HONEYWELL</td>
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<td>19</td>
<td>CTS &amp; PT’S</td>
<td>ELECTRIC POWER EQPT./ EASTERN SWITCHGEAR/ AUTOMATIC ELECTRIC/ POLYCRETE LTD. / KAPPA/ ABB /CONTROL &amp; SWITCHGEAR COMPANY LTD. / MAX ENERGY PVT. LTD./APE POWER PVT. LTD.</td>
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<td>20</td>
<td>L.T. CONTACTOR</td>
<td>SIEMENS/ L &amp; T/ BHARATIA INDUSTRIES LTD./ GE INDUSTRIAL / ANDREW YULE/ JYOTI/ HAVELL’S/ KIRLOSKAR SYSTEMS/ ABB /TELEMECANIQUE</td>
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<tr>
<td>21</td>
<td>PUSH BUTTON; INDICATING LAMP</td>
<td>L&amp;T/ SIEMENS/ ESSEN/ BCH/ BHARATIA INDUSTRIES LTD/ RASS CONTROLS. L&amp;T/ KAYCEE/ JYOTI/ ESSEN/ SIEMENS</td>
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<td>22</td>
<td>CONTROL SWITCHES</td>
<td>SIEMENS/ L&amp;T/ BHARATIA INDUSTRIES LTD./ ANDREW YULE/ GE INDUSTRIAL/ JYOTI/ CROMPTON GREAVES/ HAVELL’S/ TELEMECANIQUE / ABB/ CONTROL &amp; SWITCHGEAR COMPANY / MINILEC (INDIA) PVT LTD /STANDARD ELECTRICALS LTD./ BIECCO LAWREE LTD</td>
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<td>23</td>
<td>ISOLATING SWITCHES/ SOFT STARTERS</td>
<td>JYOTI/ NGEF/ SIEMENS/ KIRLOSKAR SYSTEMS/ BHEL/ ABB/ EASUN/ MEI / CONTROL &amp; SWITCHGEAR COMPANY/STANDARD ELECTRICALS LTD.</td>
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<td>24</td>
<td>H.T. LOAD BREAK SWITCH</td>
<td>JYOTI/ NGEF/ SIEMENS/ KIRLOSKAR SYSTEM/ ANDREW YULE/ APLAB/ ABB/ ALLEN BRADLEY/ BHARTIA INDUSTRIES LTD/ MINILEC (INDIA) PVT LTD/ SKYTONE</td>
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<tr>
<td>25</td>
<td>CONTROL CONSOLE WITH COMPONENT</td>
<td>L&amp;T/ SIEMENS/ JYOTI/ NGEF/ GE INDUSTRIAL/ KIRLOSKAR SYSTEM/ ANDREW YULE/ APLAB/ ABB/ ALLEN BRADLEY/ BHARTIA INDUSTRIES LTD/ MINILEC (INDIA) PVT LTD/ SKYTONE</td>
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<tr>
<td>26</td>
<td>BATTERY &amp; BATTERY CHARGER</td>
<td>CHLORIDE/ STANDARD/ AMCO</td>
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<td>27</td>
<td>LIGHTENING ARRESTER</td>
<td>ICE/ OBLUM/ IGE (I) LTD./ WS INSULATORS/CROMPTON GREAVES</td>
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<td>28</td>
<td>WELDING</td>
<td>ADVANI OERLICON/ INDIAN OXYGEN/ PHILIPS/ ESAB</td>
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<td>Sl. No</td>
<td>ITEM DESCRIPTION</td>
<td>NAME OF APPROVED MANUFACTURERS</td>
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<td>29</td>
<td>TRANSFORMER/ MG WELDING SET</td>
<td>JYOTI/ BHEL/ KIRLOSKAR ELECTRIC/ CROMPTON GREAVES/ AVK-SEG CONTROLS LTD.</td>
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<td>ALTERNATOR</td>
<td>KIRLOSKAR ELECTRIC/ CUMMINS/ LEYLAND / JYOTI/ SRI RAM HONDA/ YAMAHA</td>
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<td>31</td>
<td>DG SET</td>
<td>R.K. ELECTRICALS/ ESSEN/ SIEMENS/ TECHNOCRAT/ PHOTO CONTROL/ JAYSHREE ELECTRONICS/ BHARTIA INDUSTRIES LTD/ SAIT Mine Line./BIECCO LAWREE LTD.</td>
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<td>32</td>
<td>LIMIT SWITCH, PULL CORD SWITCH, BELT SWAY SWITCH, CENTRIFUGAL SWITCH</td>
<td>BCH/ TELEMECANIQUE/ L&amp;T/ SIEMENS/ GE INDUSTRIAL / ABB/ MINILEC(INDIA) PVT LTD.</td>
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<td>33</td>
<td>TIMER</td>
<td>ELECTROMAG/ PBL/ Industries syndicate / BCH</td>
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<td>34</td>
<td>ELECTRO MAGNETIC BRAKE</td>
<td>AEP/ IMP</td>
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<td>35</td>
<td>METERS</td>
<td>L&amp;T/ SIEMENS/CROMPTON/ BHARTIA INDUSTRIES LTD/ RASS CONTROLS/ BIECCO LAWREE LTD.</td>
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<td>36</td>
<td>SELECTOR SWITCH</td>
<td>GE INDUSTRIAL / L&amp;T/ SIEMENS/ STANDARD/ ABB/ CONTROL &amp; SWITCHGEAR COMPANY LTD/ STANDARD ELECTRICALS LTD.</td>
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<td>37</td>
<td>HRC FUSE</td>
<td>TULLU/ NATIONAL</td>
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<td>38</td>
<td>HOOTERS</td>
<td>ACCAIREE/ BLUE STAR/ VOLTAS/ GODREJ/ CARRIER/LG</td>
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<td>39</td>
<td>TRANSWITCH UNIT</td>
<td>TRANSGIETZ</td>
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<td>40</td>
<td>UNITIZED SUBSTATION</td>
<td>TRANSGIETZ</td>
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<td>41</td>
<td>HV FIELD SWITCH (.6 kV)</td>
<td>TRANSGIETZ</td>
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<tr>
<td>42</td>
<td>DSC, SCADA, CCTV, RTU for sub-station automation and electrical SCADA</td>
<td>HONEYWELL</td>
</tr>
</tbody>
</table>
LIST OF FOLLOWING VENDORS ARE ALSO INCLUDED IN ADDITION TO EARLIER VENDORS LIST

MECHANICAL

Air blast.... M/s Kaveri ultra polymers (P) Ltd. kolkata 700007
Belt Scraper M/s Kaveri ultra polymers (P) Ltd. kolkata 700007
Belt tracking system M/s Kaveri ultra polymers (P) Ltd. kolkata 700007
Rubber liner M/s Kaveri ultra polymers (P) Ltd. kolkata 700007
Poly urethane liner M/s Kaveri ultra polymers (P) Ltd. kolkata 700007
Pu Screen M/s Kaveri ultra polymers (P) Ltd. kolkata 700007
Dust suppression System M/s Kaveri ultra polymers (P) Ltd. kolkata 700007
Spill stop sealing system M/s Kaveri ultra polymers (P) Ltd. kolkata 700007
Polymer liner M/s Kaveri ultra polymers (P) Ltd. kolkata 700007
Impact pad M/s Kaveri ultra polymers (P) Ltd. kolkata 700007
Ceramic liner M/s Kaveri ultra polymers (P) Ltd. kolkata 700007
Conveyor belt M/s Jonson Rubber Industries , New Delhi 110005
Coupling ( Flexible / Geared ) M/s ESBI HI – Flex Pvt. Ltd, Kolkata- 700017
Building Wires M/s Siechem, Chennai- 60001
Heat shrinking tubes M/s Siechem, Chennai- 60001
Heat shrinking Sleeves M/s Siechem, Chennai- 60001

ELECTRICAL

Vacuum Circuit breaker M/s Megawin switchgear Pvt.Ltd.,
M/s SAIT, Mineline Pvt.Ltd Kol- 700033
M/s Amiya Industries Kol- 700078
Vacum Control Panel M/s Amiya Industries Kol- 700078
M/s Megawin switchgear Pvt.Ltd.,
Air break Switchgear M/s Megawin switchgear Pvt.Ltd.,
Motor Starter / Motor control Centres M/sSAIT, Mineline Pvt.Ltd Kol- 700033
M/s Amiya Industries Kol- 700078
Power control centres M/s Amiya Industries Kol- 700078
Relays M/sSAIT, Mineline Pvt.Ltd Kol- 700033
<table>
<thead>
<tr>
<th>Item</th>
<th>Supplier</th>
</tr>
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<tbody>
<tr>
<td>Relay control Panel</td>
<td>M/s Megawin switchgear Pvt.Ltd., M/s Amiya Industries Kol- 700078</td>
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<td>Power lighting distribution board</td>
<td>M/s Megawin switchgear Pvt.Ltd., M/s Amiya Industries Kol- 700078</td>
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<td>Metering panel, junction Box</td>
<td>M/s Amiya Industries Kol- 700078</td>
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<tr>
<td>PE/PVC/XLPE Insulated Power cables</td>
<td>M/s Siechem, Chennai- 60001</td>
</tr>
<tr>
<td>Signal, Instrumentation &amp; Data cables</td>
<td>M/s Siechem, Chennai- 60001</td>
</tr>
<tr>
<td>Communication &amp; Control System</td>
<td>M/s Amiya Industries Kol- 700078</td>
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<tr>
<td>Telecom cables</td>
<td>M/s Siechem, Chennai- 60001</td>
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<td>Hrc Fuses, CTS, PTS, Off load Isolator, Bushings &amp; Insulator</td>
<td>M/s Megawin switchgear Pvt.Ltd.,</td>
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<tr>
<td>Audio Visual Alarm</td>
<td>M/s Megawin switchgear Pvt.Ltd.,</td>
</tr>
<tr>
<td>Conveyor control system</td>
<td>M/s SAIT, Mineline Pvt.Ltd Kol- 700033</td>
</tr>
</tbody>
</table>
PART – I  GENERAL

1.0 Name of the company
2.0 Nature of the company
   (Proprietary/partnership/Private/Public Limited)
   (Attach photocopy of articles of association/
   Registration/Partnership/Deeds etc.)
3.0 Registered office
4.0 Works address
5.0 Name of chief executive
6.0 Name of the person to be contacted for this bid
   (Furnish photocopy of attorney)
7.0 OFFICE :
   • Telephone no :
   • Fax No:
   • E-mail :
   • Web site, if any
8.0 WORKS :
   • Telephone no :
   • Fax No:
9.0 Total area of the factory
   • Covered
   • Uncovered
   • Factory layout
10.0 Total number of employees
   • Managerial
   • Technical
   • Administrative
   • Support services
11.0 Organisation chart
12.0 Range of products manufactured
   (Enclosed all relevant technical catalogue and literature)
13.0 Year of commencement of manufacturing
## PART – II    TECHNICAL

1.0 Details of major products manufactured
   - **Type**
   - **Size**
   - **Description**
   - **Annual production for preceding three Years**

2.0 Has your product been tested by any agency? If yes, indicate details, copies of qualification approval, test certificates, test reports etc.

3.0 Foreign Collaboration (if any)
   - **Products covered**
   - **Name and address of collaborator**
   - **Status of collaboration**
   - **Scope of involvement and responsibility with respect to this bid, if any.**
   - **Proof in support thereof**

4.0 Details of plant and machinery
   - **Include list of major items of plant and equipment relevant to the products under considerations.**

5.0 Have you supplied the product similar to product under consideration to other firm? If yes, furnish name of such firm(s) & details of such product.

6.0 Quality Assurance
   - **How is the quality assurance function carried out? Give its organization and linkage with the Chief Executive.**
   - **Are there written procedures for all quality related activities?**
   - **If the firm is ISO 9000 certified company, then please attach a copy of the certificate showing range of product covered & its validity.**

7.0 Do you have an R & D Department?
   - **If so, furnish details of its infrastructure and laboratory test facilities.**

8.0 How is quality control of raw materials, purchased items exercised? If goods
coming in are inspected, provide following details:
- Test equipment and facilities available in factory
- Assistance from external agencies
- Description of test(s)
- Name of the agency carrying out the tests(s)

9.0 Inspection and quality control of finished products
- Test equipment and facilities available in factory
- Assistance from external agencies.

10.0 Principal customers
- Name and address
- Product indication there operating parameters
- Sales for last two years
- User’s performance certificates

11.0 Future Expansion
- Programme
- Installation of new machinery
- Any other information you would like to provide

12.0 Process plan / flow chart of product under consideration

13.0 Product brochures

14.0 Details of BIS licence, if any

15.0 Outsourcing activities for product under consideration (if any)
- Activities to be outsourced

- List of out source agencies for each activity and their official address
- List of P&M & testing facilities available with outsourced agencies
- List of product manufactured by outsourced agencies
- List of client of outsourced agencies
- Attach copy of order received from client for outsourcing agency and performance certificate, if any
- Any other information about outsourced agencies (whether ISO certified, BIS licence holder etc.)
PART – III COMMERCIAL

1.0 Name and address of your banker(s)

2.0 Value of current assets as on date

3.0 Value of current liabilities as on date
   (Attach balance sheets for last three years)

4.0 Net fixed assets

5.0 Value of total sales during the previous years

6.0 Value of orders in hand, enclose copy of supply order

7.0 Value of total capital employed

8.0 Balance sheet of last year

9.0 Source of finance

10.0 Borrowing limit as sanctioned by bank, if any

11.0 Are your products covered by warranty, if so, state
   • Period
   • Scope of warranty
1. **General**

Crusher shall be provided for crushing the coal to (–)250mm size. Crusher shall be supplied complete with accessories.

1.1 **Duty of Single Roll Crusher:**

The following points shall be considered before selecting the crusher:

I. Crusher will operate on average for 15 hours a day over 330 days per year in general, but the design of the crusher should be such that it can be operated for all the 365 days, for 24 hours per day, if required.

II. The crusher shall have a feed size up to 1200 mm x 1000 mm x 1000 mm in general but occasional pieces bigger than this dimension cannot be ruled out. The crushing capacity shall be 1200 TPH (nominal) 1400 TPH (peak) of ROM feed with desired product size of (–)250 mm (95% minimum). Over size, if any should not be more than 300mm in any direction.

III. The crusher will be operated continuously and therefore, provision for running and preventive maintenance should be incorporated in such a way that it can be performed during operation period.

IV. The crusher design should be such that it should be able to start in the full load condition and choke feeding condition.

V. The crusher is required to operate in heavily dusty atmosphere and for this, necessary design measures should be taken especially for electrical, lubrication and hydraulic installations.

VI. Occasionally, ROM feed may contain some metallic pieces of large size such as excavator teeth and track pads etc. Necessary protection should be incorporated in the design to take care of this.

VII. The crusher is required to operate in ambient temperature varying from 4° to 50°C with relative humidity up to 100%.

VIII. For deciding the size of crusher, crushing strength of 1200 kg/cm² & 1600 TPH considering the worst scenario viz. crushing only coal with 20% moisture & 30% shale.
IX Percentage of shale will be 30% maximum. Therefore crusher selection shall be on the basis of most critical situation.

X Bulk density of shale shall be decided by the bidder after conducting lab test. The test report shall be submitted along with the drawing for approval.

XI The percentage of moisture in rainy season may go upto 20%. The crusher shall be selected considering the worst scenario i.e. crushing only coal with 20% moisture.

XII The crusher shall have a feed size up to 1200mm x 1000mm x 1000mm in general but occasional pieces bigger than this size shall be controlled by the rock breaker.

XIII The crusher shall be robust enough to take direct impact of big boulders from the receiving pit.

XIV) Any other details required for selection of crusher shall be decided by the bidder in light of NIT and above clarification.

2. Compliance With Standards
The design, selection, and construction of equipment, components and material shall conform to relevant Indian Standard Specifications and Codes of Practice incorporating the latest revisions or in their absence to equivalent BS/DIN/AMERICAN Standards.

3.0 Coal Characteristics
The ROM coal will have the following physical characteristics :-

I. Bulk Density :-
   a) For volumetric calculation - 0.8 t/cu.m
   b) For weight / power calculation - 1.15 t/cu.m

II. Hard Groove Index (HGI) - up to 70

III. Compressive strength - up to 1200 kg/cm²

IV. Moisture
   a) Inherent - 7% to 10%
   b) Surface - 15% but may go up to 20%

V. Percentage of shale and sand stone - up to 30%
VI  Size distribution  -In ROM feed material lump size (+) 1200mm is expected to be approximately 80% by weight and (+) 1500 mm size may vary from 15% to 20%

VII.  Abrasiveness  -Abrasive

4.0  Constructional Features

In general the equipment shall be of extra heavy-duty type and robust in construction and complete with all necessary technical features/requirements to suit the envisaged duty conditions and performance parameters. The constructional feature should be such that it provides easy approach to all the components for the Inspection, maintenance, repairs etc. At the same time it can be easily dismantled and assembled whenever required. In particular, it shall have the following specific technical features.

4.1  Base Frame :
The base frame shall be constructed from heavy steel plates and structural sections to withstand heavy shocks and loads. The base frame shall be a rigid frame. Suitable holes should be provided in the base frame for fixing and the crusher on beams/columns by foundation bolts.

4.2  Housing :
The crusher housing shall be made of suitably stiffened heavy steel plates. The housing shall also be provided with necessary inspection doors. The housing shall be easily removable for maintenance and replacement of crusher rolls. Feed and discharge opening shall be provided with flanges for connecting chutes.

4.3  Crusher Rolls :
This shall be of axial segmented / circular segmented rolls / rings and shall be cast from 12 to 14% Mn steel. or chrome molybdenum steel. Alternatively, it can be of integral roll type cast from high alloy steel of equivalent strength. The segmental rolls / rings shall be clamped together to form a complete roll-shell. The tooth profile shall be designed suitably to meet the duty conditions and produce minimum of fines not exceeding 5%.

The diameter and length of the roll should be such that it can deal with the largest lump size specified. The crusher rolls should be statically and dynamically balanced. The arrangement of crusher roll should be such that it can be taken-out
and replaced in the same position easily in the least possible time.

4.4 **Breaker Plate** :

(Not applicable in case of Double Roll Crusher)

The breaker plate shall be constructed of heavy fabricated steel frame with easily replaceable linear plate. The linear plates shall be suitably designed teeth like projections of mild steel which can be suitably hard faced with special hard facing electrodes.

4.5 **Shafts** :

Shafts shall be made of high strength alloy steel / forged steel of C – 40 or equivalent quality. The segmented rolls / rings shall be mounted on suitably designed spider or rotor body for fast replacement and maintenance. The rotor body shall be keyed to the shaft. The arrangement for the fixing of segmented rolls / rings over the rotor shall be positive type to avoid any chances of relative movement between them. If jack-shaft is used, its material shall be similar to that of main-shaft.

4.6 **Bearing** :

The shaft shall run in amply dimensioned self aligning spherical roller bearings mounted on taper sleeves for quick removal. The bearing shall be housed in a cast steel plummer blocks and suitably sealed against ingress of dust and moisture by providing minimum triple lip labyrinth collar with '0' rings. The bearings shall have a minimum guaranteed working life of 40,000 hrs. at the roll speed and at full load. This shall be of heavy duty type.

4.7 **Gap Setting Arrangement** :

One crusher roll / breaker plate assembly shall be floating type and shall be independently adjustable to produce the required product size. Suitable gap setting arrangement shall be provided. The roll / breaker plate movement shall be parallel to ensure uniform gap width throughout the width of roll during the crushing operation in order to prevent skew loading of the bearings and the shaft.

4.8 **Automatic Passage of Tramp-metal** :

An effective and fast acting retractable device should be incorporated in the crusher design to allow the tramp iron piece to pass through to avoid any damage to the crusher roll. It shall be capable to allow upto 400 mm tramp material pieces to pass through and also to allow the roll / breaker plate quickly to restore to its original position. The details of safety devices so incorporated in the machine should be
indicated clearly.

4.9 **Lubrication**:  
All the lubrication points shall be provided with manually operated / automatic centralized greasing system of reputed make.

4.10 **Drive Unit**:  
The crusher shall be driven by one / two motors depending upon the duty requirement through helical gear box and multiple V belts. Shear pins shall be provided for mechanical overload protection. Suitable speed monitor shall also be provided to prevent from damage in the event of rotor getting jammed and predetermined speed. In case a coupling is used between the motor and the gear box, it should be geared coupling / fluid coupling. A minimum service factor of 2.5 should be considered for gear box and it shall be guaranteed for minimum 40,000 working hours of continuous operation at full load. All the rotating parts outside the crusher body shall be suitably guarded with expanded metal in terms relevant IS code of practices.

4.11 **Feed, Outlet Chutes & Coal Receiving Pit**:  
The offer shall include a basic system drawing of receiving pit, infeed arrange, infeed chute, outlet chute and feeding arrangement of end product on to the take-off belt conveyor. The off-take alignment may be parallel to the axis of crusher roll or perpendicular to the axis of the rolls. Arrangement of infeed chute shall be such that the rolls can be removed and replaced with least disturbance. The chute shall be of flanged construction and made into parts so that they can be assembled easily. The chutes shall have provisions of wear resistant molded rubber linears of minimum 40 mm thickness.

5. **Spares**:  
Separate price for essential components of the crusher required as spares for one year/two year/three year operation should be quoted. The spares should consist of at least the following:

(a) Roll assembly complete - 1 set  
(b) Complete set of bearings with plummer blocks. - 1 set  
(c) 25% abrasion resistant crusher roll segments, in case they are provided.
6. **Maintainability**:

The tenderer should clearly indicate the following details:

a. Expected life of roll before rebuilding

b. Expected life of roll after rebuilding

c. Method and materials for rebuilding of rolls and schedules for rebuilding.

d. Maintenance schedule for crusher

e. Time required for rebuilding of teeth including its removal if required.

8.0 **Drive and Control**

The crusher shall be driven by an AC Slip ring induction motor of suitable rating which provides high starting torque for above mentioned duty conditions. This will be complete with reduction units preferably of suitable type, of gearboxes and controlled torque coupling or with V-belt and pulley arrangement. Necessary protective devices will be incorporated in the system to protect the motor from severe surge load resulting from large piece of tramp iron in the crushing chamber. The electric supply for the main motor will be at 6.6 kV AC 3 phase at 50 Cycle per second. All other auxiliary supplies for lubrication as well as hydraulic system will operate of 3 phase, 440 V at 50 Hz.

The hydraulic lubrication and electro-mechanical controls, which forms inherent part of the crusher and its auxiliaries will be in the scope of supply and will be properly designed to achieve the desired signalling and protective requirements. The power supply to the main motor and auxiliary motors will be fed from the CHP motor control centres. The sequence control and inter-lock of all auxiliary motors and other protective devices of the crusher will also form part of the scope of supply and included in the offer. Suitable protective devices shall be provided for mechanical overload.

Suitable speed monitor shall also be provided to prevent damage in the event of jamming and stopping the system with required interlocking.

**Electrical**

7.1 **Motor**:

This shall be 6600 V, 3 phase, 50 Hz. induction motor fitted with cable boxes with gland suitable for PILCDWA cable with copper conductors / PVC insulated PVC sheathed and armored cable with aluminium conductor. The motor shall be suitable for operation at (+/-) 10% voltage variation and (+/-) 3% frequency variation. The
motor shall have higher power factor say 0.98 lagging approx. at 75% to 100% full load and shall have low weight/HP ratio. Insulation shall be of class ‘F’ and enclosure as per IP-55. It shall be comply with IS-325 and other relevant Indian Standards.

7.2 **Starter**

(Separate price shall be quoted for this this shall be DOL type suitable for the duty requirement and complete with the following:

i. Contactor Starter push buttons operated of suitable rating for above Roll crusher motor. The contactor starter shall be in sheet steel enclosure / open execution complete with the following-

(a) Auxiliary contacts 2 NO & 2 NC for remote and sequence control with incoming and out-going conveyer.

(b) Motor protection relay, single phasing protection relay.

(c) Back-up HRC fuses for short circuit protection.

(d) Control coil voltage 230 Volt AC.

(e) Ammeter and Voltmeter with selector switch for feeders above 30 KW rating.

(f) Cable glands suitable for PVC insulated, PVC sheathed, armored with Aluminium conductors.

(g) Off- load isolator manually operated.

(h) Current transformer having 2 cores (one for metering and other for protecting purposes) of suitable VA burden.

(i) Red, Green, and Yellow indicating lamps.

8. **GENERAL**

8.1 **Compliance with Standards**

The design, selection, guarding, construction of equipment, component and material shall conform to relevant Indian Standards Specifications and Codes of practices incorporating latest revisions or in their absence to equivalent BS/DIN/USA Standards.
8.2 **Drawing**:

This shall conform to IS-696. All dimensions shall be in milli-meters. The final drawing shall be submitted for approval within one month of placing of supply order.

8.3 The manufacturer shall supply four sets of operation and maintenance manual, spare parts list (including one set to CMPDIL) free of charge.

9. **Inspection and quality control before dispatch**:

9.1 **Inspection and Quality Control Before Despatch**

i) **Special Material**

The manufacturer should furnish during inspection without extra charge test certificates covering mechanical properties and chemical composition for special raw materials used including that of liners. The certificates should be from the accredited testing laboratories like CMERI-Dhanbad, NPL-New Delhi, etc. If considered necessary, samples for material may be selected as per IS : 1548 (Current) by the Employer’s representative from amongst the raw materials and manufactured components of equipment and got tested in the approved laboratory. In case samples so selected fail to meet the standard specifications, the whole lot of manufactured components will be rejected and disqualified for use again for any of the Employer’s supplies.

ii) **Stage Inspection**

Employer reserves the right to carry out inspection at any stage of the process of manufacture and assembly for which all facilities will be provided by the Contractor. Before carrying out such inspection, necessary information will be given to the manufacturer by the Contractor.

iii) **Availability of Standard Specification Meters, Gauges etc. for Testing & Inspection**.

The manufacturer will maintain all relevant standards and codes of practice for manufacture, inspection and testing of components of the equipment ordered. He will also maintain a set of meters, gauges etc. as may be required for testing and inspection of components.

9.2 **Testing & Inspection**

The details of the checks to be carried for various components are to be submitted by the contractor for Owner’s approval. However, some indicative checks on different items are given below which should necessarily form part of the quality assurance programme to be agreed with the Owner.
9.2.1 All plates above 20mm thickness to be ultrasonically tested for laminations.

9.2.2 Shaft forgings and castings to be checked for hardness, microstructure and ultrasonic testing in addition to check for chemical and mechanical properties.

9.2.3 Following minimum NDT requirements to be ensured for welds.
   i) Butt welds : 10 % Ultrasonic / Radiographic and 100 % MP/ DP test
   ii) Fillet welds : 10% Magnetic particle/ DP test

10. **Delivery period**
    Shortest possible delivery period should be indicated by the tenderer.

11. **TECHNICAL DETAILS REQUIRED WITH THE OFFER**
    The tenderer shall include following details along-with each copy of their offer (in triplicate) failing which the offer shall be treated incomplete and may be passed over. These shall be in addition to any other details as asked for else-where in this specification.

11.1 **Capacity**

11.1.1 Rated capacities of the crusher in tones/hour at indicated feed size and product size.

11.1.2 Capacities at different product sizes in tonnes/hour at indicated feed size and different product sizes referred above along with % of oversize and size of max. lumps in the product.

11.2 **Drawings**

11.2.1 Dimensional general arrangement drawing of complete crusher with motor along with relevant details viz. shaft diameter, roll diameter, roll length etc.

11.2.2 Foundation arrangement drawings and anchor bolts position of the crusher with motor. Impact allowance of crusher for crusher foundation design.

11.2.3 Roll construction details, diameter and width.

11.2.4 Any special features incorporated to ensure uniform product size.
11.3 **Weight** :

Weight of crusher with motor, weight of the single heaviest part of the crusher.

11.4 **Bearings** :

Type and size of bearings, make of bearings.

11.5 **Materials** :

Material offered for crusher shaft, roll etc. including their tensile strength in Kg/sq.cm. elongation % and Brinell hardness number.

11.6 **Power Requirement** :

Horse Power absorbed at the crusher shaft.

11.7 **Drive arrangement details.**

11.8 **Construction features in detail to highlight the different functions as described in clause – 3 above including the following specific features :**

   i. Gap setting arrangement for rolls.

   ii. Power distribution arrangement for drive unit.

   iii. Details of fast acting retractable device.

11.9 **Electrical (Separate price shall be quoted)** :

Details of motor, make, type frame size, rated current, starting current, starting torque, rated torque, pull out torque and any other relevant details shall be indicated in the offer. All relevant technical details including make, type, size etc. for the starter shall be furnished. Manufacturer's descriptive technical pamphlet for motor and starter shall be furnished.

11.10 **Life** :

The tenderer shall clearly indicate minimum guaranteed roll life at rated capacity.

11.11 **Makers descriptive pamphlet.**

11.12 Calculation in support of power required for the crusher.

11.13 Calculation in support of capacity of the crusher, diameter of the roll.
12. **Informations to be supplied along with the drawing after placement of order.**
Manufacturer will supply six copies of drawings for approval showing therein all relevant details including that covered vide para 11.1 to 11.8 above, before start of fabrication.

13. **GUARANTEE:**
The tenderer shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated in this specification. This guarantee shall be for a minimum period of 12 months from the date of commissioning or 24 months from the date of receipt by consignee, whichever is earlier.

14. **PAST PERFORMANCE:**
The tenderers are required to furnish the following details in support of their successful past experience in manufacturing of this equipment.

14.1 Name and address of the organizations who are using similar make, type and capacity of crusher.

14.2 Material handled including maximum feed size and product size.

14.3 Year of supply of Crusher, with order number and date. (Minimum three different orders to be indicated).

14.4 User’s performance certificate, if any.

14.5 Capability of the firm in manufacturing of such equipment with Annual turnover for last 3 years.

14.6 Various facilities availability for such work.

14.7 Inspection and quality control facilities available with the firm.

15. **DEVIA TION:**
Any deviation from NIT specification must be brought at one place to facilitate proper evaluation.

16.0 **Guaranteed percentage availability:**
The equipment should be guaranteed for a minimum of 90% availability during 12 months from the date of commissioning.

The following formula will be adopted to calculate percentage availability.

\[
\frac{(\text{Total shift hours-breakdown hours-maintenance hours})}{(\text{Total shift hours})} \times 100
\]

*Total shift hours=8x no of shifts operated in 12 months including those on scheduled holidays*
SPECIFICATION OF TWIN SHAFT SIZER

1. Objective

To meet customer’s requirement and satisfaction, it has become necessary to supply (-) 100mm/50mm size of coal to customer. As such, it is necessary to apply SIZER to downsize coal from r.o.m. to the required size as above to maintain accurate size, while handling high throughput and free operation.

2. Principle of operation of SIZER

The teeth of the SIZER shall be able to continuously agitate & scroll infeed material to avoid jamming of SIZER due to wedging to avoid breakdown. The SIZER shall be able to handle oversize material without any pre-screening. The oversize material shall be repositioned within sizer by special arrangement of teets for sizing. Undersize material shall pass through the SIZER without further degradation. The SIZER shall totally control cubical & accurate size, instead of controlling only one dimension of the output.

To achieve low power consumption & minimum wear rate of the parts of SIZER, breaking of materials within sizer should be achieved by shear and tension instead of compression. By this sizer shall also produce minimum fines.

The SIZER shall be able to handle wet sticky coal or hard rock or combination of both maintaining peak throughout capacity, as stipulated in the tender document.

Easy recovery from stall situations:
In the event of stalled situations resulting from fouling by unbreakable foreign objects.

3. In plut data

Type of SIZER : Twin shaft sizer
Material : Coal
Build density : 0.8 to 1.2 ton/m3
HGI of coal/shale : 40 (for equipment design)
Compressive strength : upto 1200 kg/cm2 (for equipment design)
% of shale and sandstone : upto 30% (for equipment design)
Moisture (inherent) : 7 to 10%
Moisture (surface) : upto 15% but may be upto 20% in rainy season
Capacity : 1200 TPH (nominal) / 1400 TPH (Peak)
Input feed : 1200 x 1000 x 1000 (mm) for primary roll crusher and (-) 250mm for secondary sizer
Output size : (-)100mm / (-) 50mm (in case necessary by modification of the SIZER)

Input feed to sizer:
   a) For primary sizing : from 25 te tipping truck through apron feeder
   b) For secondary sizing : Feed directly primary roll crusher
Duty : Continuous
Main features for electricals : to be indicated

4. General construction

The SIZER shall be of extremely robust construction and of adequate strength to withstand heavy-duty operation of both Mine and Quarry. The SIZER shall be designed to contain the breaking forces within its own framework, and transfer minimal forces to its surrounding structures. The SIZER shall be of low height & compact dimension. The SIZER shall be of lighter weight, so that it can be installed with minimum support and avoid heavy civil foundation. Installation of SIZER shall have no interference or very minimum interference with any existing structures.

Framework
The machined side frames shall be of ribbed construction fabricated from substantial horizontal and vertical ribs. The top and bottom flanges of the side plates shall be suitably drilled to readily accept the fitting hoppers and chute work. Easily replaceable steel wear plates shall cover the inside area of the sizing chamber.

Lubrication
The SIZER shaft-bearing assemblies shall be designed with labyrinth type bearing housing and optimize a constant purging system. Lubrication will be via an automatic greasing system to labyrinth seals from a direct feed lubricator to prevent contamination.

Bearings
SKF self-aligning double row spherical roller bearings shall be housed in a ribbed fabricated steel housing.

Shafts
Two rotor shafts shall be fitted to the bearings and shall be splined to accept the driving gears and keyed to accept the ring or barrels. The shafts shall be machined from high strength alloy steel and heat-treated.

The splines shall be of side fitting flat root type of involute form. This will ensure that no possibility of radial movement can occur, thus removing any possibility of fretting which in turn ensures optimum life.

Tooth Cap/Tip/Segments
The replaceable caps/tips and segments shall be hardened and tempered steel castings to appropriate specification of steel, which will have a long life. The Tooth/Segments are fitted in such a manner to get scrolled movement in either direction to have a better grip on large size material.

5. Drives
The SIZER shall be driven by electric motors through hydraulic fluid couplings and reduction gearbox, connected to the SIZER shafts by gear couplings.

Motors
6.6 kV Motors shall be totally enclosed fan ventilated and tropicalised. They shall be fitted
with thermistors embedded in phase of the stator winding to protect the motor against overload stalled rotor, overheating, etc. Motors shall be fitted with anti-condensation heaters.

**Fluid Couplings**  
Because of the violent action of the Sizing Concept very high shock loads can be developed. For this reason a fluid coupling shall be employed to give a controlled damping effect, and ultimately due to internal slippage at high torque, allow the machine to stall without damage to the transmission.

**6. Gearbox Gears**  
All gears shall be manufactured in a high quality carburizing steel, case hardened to maintain core ductility and give a high surface hardness value. The gears shall be finished ground to give a very high accuracy mesh and the tips shall have a refinement, (tip relief) applied to compensate tooth deflection as a tooth enters the loaded mesh zone and prevents tip damage.

Tooth roots are left un-ground with full fillets to gain an advantage with residual compressive stresses and minimum stress concentration.

Through utilizing the versitality of the modern involute system, the tooth geometry is optimized and designed to withstand static short duration overload.

**Gearbox Bearings**  
Because of the extreme shock loads generated in Minerals SIZERS, the selection of bearings is of particular importance. The input shaft can in some circumstances be subject to an erratic load condition, which is accounted for in design. This shall be overcome by use of taper roller bearings, which shall give the advantage of driving the roller set through the full 360°, minimizing risk of cage damage.

Other bearings shall be Spherical Roller, which whilst slowing constraint of axial as well as radial forces, are tolerant of misalignment due to shaft deflection, etc. Bearings shall be selected such that the lesser of L10h and L10aah lives are a minimum of 60,000 hours. The effects of lubrication, contamination and temperature shall be considered in the selection. Other considerations are potential damage due to the machine running light and static capacity at maximum load.

**Gearbox Shafts**  
Most shafts shall be integral parts of gears enabling simple, reliable power transmission between gear sets.

**Gearbox Seals**  
Seals shall be made of medium nitrilite rubber or fluorocarbon. All seal paths shall be replaceable manufactured in hardened steel. On the output side path shall be surface hardened to by a nitriding process. On input hard chrome plate on the seal path shall have to be provided to improve seal life.

**Gearbox Casing**  
The casing shall be cast to enable ease of forming complex shapes and shall be made
from spherodial graphite iron material. The material shall have high tensile strength whilst maintaining good elongation.

**Gearbox Keys**
All keys shall be of full strength and shall be made from high tensile alloy steel.

**Gearbox Bolting**
Bolts shall be adequately sized to restrain the forces within the casing and shall be torque controlled.

**Gearbox Couplings**
The output coupling shall be gear type designed to accomadate small misalignment via special tooth crowning whilst maintaining capacity to transmit high torque levels. The input coupling shall be VOITH hydraulic type (see fluid coupling section), thus giving good torque overload protection to the gearbox.

**Gearbox Lubrication**
For simplicity splash lubrication shall be employed within the gearbox.

**Gearbox Testing**
Gearboxes shall be subjected to a thorough running test before dispatch incorporating vibration and temperature monitoring. All major components shall be quality controlled by NDT. Test such as ultrasonic to inspect soundness of material. As well as dimentional inspection and mechanical tests on test pieces where applicable.

**7. Design, Manufacturing and Quality Control**
The design, manufacture and quality control of SIZER shall conform to internationally accepted standards (ISO 9001 – 1987 or equivalent). The product shall have proven track record of performance of continuous operation, high availability and throughput being achieved. The necessary proofs in respect of quality control and satisfactory performance and achieved throughput shall have to be submitted with the offer.

**8. Safety**
The equipment shall comply with latest international protection regulations (S.I 472 & S.I 507)

**Data to be furnished for SIZER along with the offer**

i.) SIZER type  
ii.) SIZER model  
iii.) Overall dimension (length X width X height)  
iv.) Weight of SIZER  
v.) Feed size  
vi.) Product size (three dimensions)  
vii.) Number of rolls  
viii.) Roll length/ center distance  
ix.) Roll speed  
x.) No. of teeth per segment  
xii.) Bearing type  
xii.) Type of gear box
Documents in respect of Quality Assurance and performance report.

9. **Inspection and quality control before dispatch**:

9.1 **Inspection and Quality Control Before Despatch**

i) **Special Material**

The manufacturer should furnish during inspection without extra charge test certificates covering mechanical properties and chemical composition for special raw materials used including that of liners. The certificates should be from the accredited testing laboratories like CMERI-Dhanbad, NPL- New Delhi, etc. If considered necessary, samples for material may be selected as per IS : 1548 (Current) by the Employer's representative from amongst the raw materials and manufactured components of equipment and got tested in the approved laboratory. In case samples so selected fail to meet the standard specifications, the whole lot of manufactured components will be rejected and disqualified for use again for any of the Employer's supplies.

ii) **Stage Inspection**

Employer reserves the right to carry out inspection at any stage of the process of manufacture and assembly for which all facilities will be provided by the Contractor. Before carrying out such inspection, necessary information will be given to the manufacturer by the Contractor.

iii) **Availability of Standard Specification Meters, Gauges etc. for Testing & Inspection**

The manufacturer will maintain all relevant standards and codes of practice for manufacture, inspection and testing of components of the equipment ordered. He will also maintain a set of meters, gauges etc. as may be required for testing and inspection of components.

9.2 **Testing & Inspection**

The details of the checks to be carried for various components are to be submitted by the contractor for Owner's approval. However, some indicative checks on different items are given below which should necessarily form part of the quality assurance programme to be agreed with the Owner.
9.2.1 All plates above 20mm thickness to be ultrasonically tested for laminations.

9.2.2 Shaft forgings and castings to be checked for hardness, microstructure and ultrasonic testing in addition to check for chemical and mechanical properties.

9.2.3 Following minimum NDT requirements to be ensured for welds.
   i) Butt welds : 10 % Ultrasonic / Radiographic and 100 % MP/ DP test
   ii) Fillet welds : 10% Magnetic particle/ DP test

10. **Delivery period**:
    Shortest possible delivery period should be indicated by the tenderer.

11. **TECHNICAL DETAILS REQUIRED WITH THE OFFER**:
    The tenderer shall include following details along-with each copy of their offer (in triplicate) failing which the offer shall be treated incomplete and may be passed over. These shall be in addition to any other details as asked for elsewhere in this specification.

11.1 **Capacity**:
    Rated capacities of the crusher in tones/hour at indicated feed size and product size.

    Capacities at different product sizes in tonnes/hour at indicated feed size and different product sizes referred above along with % of oversize and size of max. lumps in the product.

11.2 **Drawings**:

11.13.1 Dimensional general arrangement drawing of complete crusher with motor along with relevant details viz. shaft diameter, roll diameter, roll length etc.

11.13.2 Foundation arrangement drawings and anchor bolts position of the crusher with motor. Impact allowance of crusher for crusher foundation design.

11.13.3 Roll construction details, diameter and width.

11.13.4 Any special features incorporated to ensure uniform product size.
11.14 **Weight** :

Weight of crusher with motor, weight of the single heaviest part of the crusher.

11.15 **Bearings** :

Type and size of bearings, make of bearings.

11.16 **Materials** :

Material offered for crusher shaft, roll etc. including their tensile strength in Kg/sq.cm. elongation % and Brinell hardness number.

11.17 **Power Requirement** :

Horse Power absorbed at the crusher shaft.

11.18 **Drive arrangement details.**

11.19 **Construction features in detail to highlight the different functions as described in clause – 3 above including the following specific features :**

   iv. Gap setting arrangement for rolls.

   v. Power distribution arrangement for drive unit.

   vi. Details of fast acting retractable device.

11.20 **Electrical (Separate price shall be quoted)** :

Details of motor, make, type frame size, rated current, starting current, starting torque, rated torque, pull out torque and any other relevant details shall be indicated in the offer. All relevant technical details including make, type, size etc. for the starter shall be furnished. Manufacturer’s descriptive technical pamphlet for motor and starter shall be furnished.

11.21 **Life** :

The tenderer shall clearly indicate minimum guaranteed roll life at rated capacity.

11.22 **Makers descriptive pamphlet.**

11.23 **Calculation in support of power required for the crusher.**

11.24 **Calculation in support of capacity of the crusher, diameter of the roll.**
12. **Informations to be supplied along with the drawing after placement of order.**
Manufacturer will supply six copies of drawings for approval showing therein all relevant details including that covered vide para 11.1 to 11.8 above, before start of fabrication.

13. **GUARANTEE:**
The tenderer shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated in this specification. This guarantee shall be for a minimum period of 12 months from the date of commissioning or 24 months from the date of receipt by consignee, whichever is earlier.

14. **PAST PERFORMANCE:**
The tenderers are required to furnish the following details in support of their successful past experience in manufacturing of this equipment.

14.1 Name and address of the organizations who are using similar make, type and capacity of crusher.
14.2 Material handled including maximum feed size and product size.
14.3 Year of supply of Crusher, with order number and date. (Minimum three different orders to be indicated).
14.4 User’s performance certificate, if any.
14.5 Capability of the firm in manufacturing of such equipment with Annual turnover for last 3 years.
14.6 Various facilities availability for such work.
14.7 Inspection and quality control facilities available with the firm.

15. **DEVIATION:**
Any deviation from NIT specification must be brought at one place to facilitate proper evaluation.

16. **Guaranteed percentage availability:**
The equipment should be guaranteed for a minimum of 90% availability during 12 months from the date of commissioning.

The following formula will be adopted to calculate percentage availability.

\[
\text{Percentage Availability} = \left( \frac{\text{Total shift hours} - \text{breakdown hours} - \text{maintenance hours}}{\text{Total shift hours}} \right) \times 100
\]

(Total shift hours=8x no of shifts operated in 12 months including those on scheduled holidays)
1.0 Duty

The rock breaker will be used for raking & breaking of the oversize lumps (above 1200 mm) of coal, shale or sand stone retained on the grizzly of the crushing plant / on the crusher.

2.0 Compliance with Standards

The design, selection, and construction of equipment, components and material shall conform to relevant Indian Standard Specifications and Codes of Practice incorporating the latest revisions or in their absence to equivalent BS/DIN/American Standards.

3.0 Type: This shall be pedestal mounted fixed type

4.0 Operational Parameters

   i) Minimum horizontal reach from centre line of rock breaker swing : 12 m (min)
   ii) Minimum vertical reach with breaker : 9 m (min)
   iii) Swing rotation of the rock breaker : $150^\circ$ (minimum)
   iv) Size of grizzly opening : 1200 mm X 1200 mm
   v) Type of rock : Coal, sandstone or shale.
   vi) Feed rate over grizzly : 1600 tph.
   vii) Proportion of over size lumps : 15% to 20%
   viii) Compressive strength of coal / shale : Up to 1200 kg/sq. cm.
   ix) Size of oversize lumps : Up to 3000 mm.
   x) Grab attachment : To lift 3000mm size lump

5.0 Constructional Features

The rock breaker will be a stationary installation. It will be mounted on a structural pedestal located of the edge of the receiving hopper. The rock breaker will be provided with an operator’s cabin and should have the following constructional features.

5.1 Boom

This shall be constructed of high strength alloy steel and will be amply dimensioned to withstand side, torsional and bending loads during raking and manoeuvring of over sized lumps and severe shock loads imparted during breaking.
5.2 **Hydraulic Cylinders**

All cylinders will be hydraulically operated. The cylinders and rods will be designed for above the duty for which it is required and ample dimensioned. These will be fitted with self-aligning bushings to take side loads during raking. The pivot pins and bushings fitted to cylinders and booms will be suitably selected to prevent ingress of dust and moisture and to provide for longer life.

5.3 **Breaker**

The breaker will be hydraulically operated and will provide trouble free operation during breaking. The breaker shall be provided with a protective housing to prevent the damage of breaker due to raking operation. The breaker will be designed to suit the duty conditions required and will impart sufficient energy to break oversized lumps. The breaker shall be capable of absorbing shocks and vibrations due to impact breaking. The noise level during breaking shall be within permissible limits (75dBA).

5.4 **Hydraulic System**

The hydraulic system should be of sufficient capacity and should be provided for the operation of all hydraulic Cylinders and equipment. The rating of the overall hydraulic equipment will be well above the duty for which it is required and will be suitable for operation in tropical climate. The rated capacity of hoses should be minimum of 3 times the working pressure of the fluid in the hosepipe.

6.0 **Cab**

The cab shall be fully enclosed with toughened glass on all sides. The cab shall be fully ventilated and shall be mounted on anti vibration pads. The cab shall also house all the controls and indicating instruments required for smooth operation of the complete equipment. The drivers seat shall be fully adjustable to suit operator's comfort.

7.0 **Control**

For operation of hydraulic Cylinders, lever operated control valve will be provided for independent control of boom hoist dipper stick swing and tilt cylinders. For breaker operation foot operated dead man type pedal control shall be provided.

8.0 **Electric Motor**

The motor will be totally enclosed fan cooled squirrel cage induction motor with class “B” insulation suitable for operation at 440V, 3 phase, 50 Hz and will be fitted with cable boxes with glands suitable for PVC insulated. PVC sheathed and armoured cable with aluminium conductor. The motor will be suitable for operation at +10% voltage fluctuations.
9.0 Inspection and Quality Control Before Despatch

i) Special Material

The manufacturer should furnish during inspection without extra charge test certificates covering mechanical properties and chemical composition for special raw materials used including that of liners. The certificates should be from the approved testing laboratories like CMERI- Dhanbad, NPL- New Delhi, etc. If considered necessary, samples for material may be selected as per IS : 1548 (Current) by the Employer’s representative from amongst the raw materials and manufactured components of equipment and got tested in the approved laboratory. In case samples so selected fail to meet the standard specifications, the whole lot of manufactured components will be rejected and disqualified for use again for any of the Employer’s supplies.

ii) Stage Inspection

Employer reserves the right to carry out inspection at any stage of the process of manufacture and assembly for which all facilities will be provided by the Contractor. Before carrying out such inspection, necessary information will be given to the manufacturer by the Contractor.

iii) Availability of Standard Specification Meters, Gauges etc. for Testing & Inspection.

The manufacturer will maintain all relevant standards and codes of practice for manufacture, inspection and testing of components of the equipment ordered. He will also maintain a set of meters, gauges etc. as may be required for testing and inspection of components.

9.1 Testing & Inspection

The details of the checks to be carried for various components are to be submitted by the contractor for Owner’s approval. However, some indicative checks on different items are given below which should necessarily form part of the quality assurance programme to be agreed with the Owner.

9.2 All plates above 20mm thickness to be ultrasonically tested for laminations.

9.3 Shaft forgings and castings to be checked for hardness, microstructure and ultrasonic testing in addition to check for chemical and mechanical properties.

9.4 Following minimum NDT requirements to be ensured for welds

i) Butt welds : 10% Ultrasonic / Radiographic and 100% Magnetic particle

ii) Fillet welds : 10% Magnetic particle
HEAVY DUTY APRON FEEDER

1.0 Duty
The apron feeder will be of robust construction and extra heavy-duty type. It will be able to take impact of coal/shale lump size indicated elsewhere from a height as indicated in Operational Parameters. It will be suitable for continuous operation for 3 shift per working day and 330 working days per year in general, but design should be such that it can operate 365 days and 24 hours /day if required. It will be able to handle wet material during rainy season without loss of efficiency. The working place may be quite dusty. Inclination of the Feeder may be up to 10 degree. The surface temperature may vary from 4 to 50 degree C and humidity may be up to 100%.

2.0 Operational Parameters

i) Material : ROM coal containing shale & sandstone up to 30% specific gravity and bulk density of 1.6 to 1.65 & about 0.8 to 1.15 t/m³, respectively Compressive strength of material may be taken as 1200 kg/sq. cm.

ii) Max lump size : 1200 mm.

iii) Free fall height : To be kept as minimum as possible.

iv) Feeder size : Width between skirts to suit system design. (Minimum 2000mm)

      Length between sprocket centres 4M & 6M or to suit system design.

v) Capacity : Nominal 1200 TPH.(Peak 1600 TPH)

      Variable 800 – 1600 TPH.

3.0 Constructional Features
In general, the construction of the Feeder will be to suit the duty requirements as stated earlier. The overlapping pans should prevent spillage. The construction materials will be such that maximum life with abrasive coal mixed with shale and sandstone could be achieved. The equipment will be easily accessible. Shafts are of forged steel machined precisely. In particular, it will have the following specific features:

3.1 Main Frame and Side Board
These will be of heavy steel construction suitably cross braced and welded with heavy cross members to withstand the repeated and continuous service conditions. The side board will be lined with replaceable liners at wear points. The side board will extend full length in order to guide material.
3.2 **Pan**

Pans are to be constructed of heavy overlapping manganese steel plates of minimum thickness 25 mm which are attached to heavy duty conveyor chains. The construction is to also eliminate any spillage from between the pans.

3.3 **Conveyor Chains**

Chains are to be made of forged alloy steel, case hardened to give a high degree of abrasion resistance. Bushings and pins are also to be case hardened in order to have sufficient tensile strength to withstand continuous severe operation for a long period. Chain seals should prevent entry of abrasive foreign materials for longer chain life. Construction should ensure that the chains are performing duty of pulling pans only. The combined breaking strength of chain should not be less than 400 tonne.

3.4 **Upper Impact Rollers**

During operation the feed point of the coal shale dropping on the apron pans are at very high level. To absorb load of impact it is desirable that the upper impact rollers are made of high quality cast steel. These impact rollers mounted on bush bearings will be rigidly placed on the upper face of the frame along the direction in which the apron proceeds. The rollers should support each pan at three points and throughout the entire length of the apron feeder.

3.5 **Return Rollers**

Return run of the apron pans will be supported by cast steel return rollers fitted on shaft with bush bearings.

3.6 **Lubrication**

The bearings are Babbitted and shall be greased occasionally. Alternatively, heavy duty bearings with proper lubrication system may also be provided. To facilitate such greasing, a centralised lubrication system with compressed air operated (for cleaning of the tubes before every filling) shall be provided. This consists of compressed air operated grease pump, distribution valves and accessories such as fittings, flexible hoses, piping and etc.

3.7 **Drive**

The apron feeder will be provided with a variable speed AC motor drive arrangement to give varying discharge. The controls indicators will be housed in dust and vermin proof steel enclosure. Suitable interlock and sequence control will also be provided. The drive will be complete with necessary speed reducers, couplings etc.
3.8 Guards

Necessary guards will be provided for all moving parts. Easy approach must be available for inspection and maintenance purpose.

4.0 Inspection and Quality Control Before Despatch

i) Special Material

The manufacturer should furnish during inspection without extra charge test certificates covering mechanical properties and chemical composition for special raw materials used including that of liners. The certificates should be from the approved testing laboratories like CMERI-Dhanbad, NPL-New Delhi, etc. If considered necessary, samples for material may be selected as per IS : 1548 (Current) by the Employer’s representative from amongst the raw materials and manufactured components of equipment and got tested in the approved laboratory. In case samples so selected fail to meet the standard specifications, the whole lot of manufactured components will be rejected and disqualified for use again for any of the Employer’s supplies.

ii) Stage Inspection

Employer/ CMPDI reserves the right to carry out inspection at any stage of the process of manufacture and assembly for which all facilities will be provided by the Contractor. Before carrying out such inspection, necessary information will be given to the manufacturer by the Contractor.

iii) Availability of Standard Specification Meters, Gauges etc. for Testing & Inspection.

The manufacturer will maintain all relevant standards and codes of practice for manufacture, inspection and testing of components of the equipment ordered. He will also maintain a set of meters, gauges etc. as may be required for testing and inspection of components.

iv) Checks during inspection:

The details of the checks to be carried for various components are to be submitted by the contractor for Owner’s approval. However, some indicative checks on different items are given below which should necessarily form part of the quality assurance programme to be agreed with the Owner.

4.1 All plates above 20mm thickness shall be ultrasonically tested for laminations.

4.2 Shaft forgings and castings shall be checked for hardness, microstructure and ultrasonic testing in addition to check for chemical and mechanical properties.
4.3 **Following minimum NDT requirements to be ensured for welds:**

i) Butt welds: 10% Ultrasonic / Radiographic and 100% Magnetic particle

ii) Fillet welds: 10% Magnetic particle

5.0 **Guaranteed percentage availability**

The equipment should be guaranteed for a minimum of 90% availability during 12 months from the date of commissioning.

The following formula will be adopted to calculate percentage availability.

\[
\frac{(\text{Total shift hours} - \text{breakdown hours} - \text{maintenance hours})}{(\text{Total shift hours})} \times 100
\]

Total shift hours = 8 x no of shifts operated through 12 months including those on scheduled holidays
1. **Basic Parameters**

<table>
<thead>
<tr>
<th>1.1</th>
<th>Type of Crane</th>
<th>E.O.T. SINGLE Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2</td>
<td>Duty of class of crane IS 807 &amp; 3177</td>
<td>Class II</td>
</tr>
<tr>
<td>1.3</td>
<td>Safe working loads in Te :</td>
<td>20t /35t</td>
</tr>
<tr>
<td>1.4</td>
<td>Whether the crane is to work in an enclosed building or outdoor</td>
<td>It is to work in receiving pit.</td>
</tr>
<tr>
<td>1.5</td>
<td>Operation speeds :</td>
<td>Main hoist- As per requirement Cross traverse-10m/min Long traverse-20m/min</td>
</tr>
<tr>
<td>1.6</td>
<td>Power Supply :</td>
<td>440 V AC 3 Phase, 50Hz.</td>
</tr>
<tr>
<td>1.7</td>
<td>Controls :</td>
<td>From cabin and also from pendant (remote)</td>
</tr>
<tr>
<td>1.8</td>
<td>Ambient temperatures: Maximum Minimum</td>
<td>50º C 4º C</td>
</tr>
<tr>
<td>1.9</td>
<td>Reach of hook</td>
<td>Up to floor of receiving pit Approx 13m from minimum level</td>
</tr>
</tbody>
</table>

This crane should be installed at an early stage to be available to assist with installation of other equipment.

2. **Constructional Features**

The equipment will be of robust construction and manufactured as per up to date engineering practices duly complying with relevant Indian Standard or in its absence with equivalent International Standard. In general, it will have the following features:

3. **Compliance With Standards**

All components, material and equipment used will comply in general, with relevant Indian / International Standards and in particular to the specifications furnished. Acceptance test will as per relevant standard and will be conducted out by manufacturer and test certificate will be furnished with equipment.

4. **Drums**

Drums will be of such size that there will be not more than one layer of rope on the drum when the rope is in its fully wound position and each lead of rope has a minimum of two full turns on the drum when the hook is at its lowest position.
One spare groove for each lead of the wire rope on the drum when the hook is at its highest position. The minimum height of the flanges on the drum ends will be double of rope diameter. The lead angle of the rope will not exceed 5 degree on either side of helix angle of the groove in the drum.

Drum will be made of cast steel conforming to the relevant IS. The diameter or the drum will be minimum of 18 times the diameter of rope. The end of the rope will be anchored to the drum in such a way that the anchorage is readily accessible. The FS of the rope will be not less than 5.

5. **Sheaves**

Sheaves will be machine grooved to a depth of not less than 1.5 times the diameter of rope. The grooves will be finished smooth and will be free from surface defects likely to injure the rope. The radius of the bottom parts of the groove will be larger than the radius of the rope by not less than 1.5 mm. Sheaves will be provided with guards to retain the ropes in the grooves, if necessary.

6. **Bearings**

All running shafts and wheels running as fixed axles or pins will be fitted with suitable size anti-friction bearings. Due allowance will be made for impact and side thrusts and, where necessary, spherical, seating and separate thrust bearings of suitable dimensions will be used. Life of bearings will be minimum of 30,000 working hours.

7. **Couplings**

All couplings will be of cast steel and will be designed to suit the maximum torque that may be developed. Alignment will be such that solid couplings mate accurately. Flexible couplings will be initially aligned with the same accuracy as solid coupling. Flexible coupling will be fitted between motor shaft, and extension shafts.

8. **Shaft**

All shafts will preferably be made of En-9 as per BS or equivalent steel. Shafts and axles will have ample strength and rigidity and adequate bearing surface for their purposes. They will where necessary, be finished smoothly and, if shouldered, will be provided with fillets of as large radius as possible and/or be tapered to suit.

9. **Gears**

All gears will be of cast steel, which may have steel rims secured to cast iron centres. Gearboxes will be so designed that the gears which they enclose will be automatically lubricated. The gear will be readily removable and the boxes will be oil tight as far as is reasonably practicable. They will be of rigid construction fitted with inspection covers and fitting lugs where necessary.
10. **Track Wheels**

Track wheels may have cylindrical or tapered (conical) treads, with flanges or any other means as and where necessary to guide the crane effectively and to prevent derailment the wheels will be mounted in such a manner as to facilitate removal and replacement, Track wheels will be of cast steel or will have steel tyres shrunk on and registered with minimum hardness as obtained earlier. The steel will not contain more than 0.060% either of sulphur or phosphorous. The hardness of the steel will not be less than 250 BHN.

11. **Brakes**

Hoisting motion will be fitted with an electro hydraulic thruster type brake. The traversing motion (CT/LT) will be fitted with a brake when the specified speed of traversing speed under full load exceeds 20 m/min. When limit switches are provided in this motion, automatic electro mechanical brakes will be provided, service brakes, parking brakes, emergency brakes will be provided as per Indian standard. Brake linings will be effectively and permanently secured to the brake shoes during the effective life of the lining, and will be protected from water, grease, oil or other adverse effects.

12. **Lifting Hooks**

The hooks used will be of plain shank type hooks. System will comprise single/two sheaves.

13. **Guarding**

All gear wheels, pinion and chain drives will be totally enclosed unless such parts are so situated in relation to the structure of the crane as to be as safe as if complete encasement were provided. Effective guards will be provided for revolving shafts and couplings unless every set screw, bolt or key on any revolving shafts is sunk, shrouded or otherwise effectively guarded. Long and cross travel shafts will be guarded throughout their length. The sheaves of hook blocks fitted with two sheaves or less, will be guarded to prevent the trapping of a hand between a sheave and the running rope.

14. **Electrical**

14.1 **Motor**

The motor will be TEFC, 50 Hz, , slip ring induction type of adequate rating, suitable for crane duty, Reversible service application having class ‘F’ insulation.

14.2 **Controller**

Controller will comply with relevant Indian Standard specification and will be adequately protected to prevent accidental contact with live parts. Cabin operated control is required.

14.3 **Cabin Switch**

The equipment will be provided with a suitable operator's cabin complete with necessary control switches etc. for operation of the equipment by the operator from the cabin and also with remote pendant switch to operate the crane from the top floor of the receiving pit complex.
14.4 Limit Switches

The limit switches, after being tripped, will automatically reset themselves within a reasonable distance travelled in the opposite direction. Limit switches will be fitted to prevent, over travelling and over traversing.

14.5 Pendant Switch

The pendant switch shall be capable of withstanding rough handling without being damaged and the cover shall be effectively secured. The weight of the pendant shall be supported independently of the electric cable by means of chain. If the pendant is of metal, it shall be effectively earthed. A chain or hook does not provide an effective earth connection and should not be relied upon for that purposes.

A means shall be provided to prevent inadvertent operation from the floor while maintenance work is being carried out on the crane.

15.0 Starter and Control Panel

This shall be adequately rated for the operation of the crane. The control panel shall have the following features and confirm to relevant IS specifications.

a) Off-load isolator

b) Circuit breaker with under voltage release and electrical/mechanical inter lock

c) Interlock with the door for the isolator

d) Protections

e) Motor control centre

f) Motor protection relay with over load, earth fault, single phase stall protection and unbalance condition, solid state

g) Cable entry box for incoming and outgoing entry

h) Enclosure shall be suitable for outdoor duty, dust/vermin proof and top canopy as per IS-55 enclosure.

i) Space heater shall be provided for motor rating 30 kW and above.

16.0 Inspection and Quality Control before Despatch

i) Special Material

The manufacturer should furnish during inspection without extra charge test certificates covering mechanical properties and chemical composition for special raw materials used including that of liners. The certificate should be from the approved testing laboratories like CMERI- Dhanbad, NPL- New Delhi. Etc. If considered necessary, samples for such material and components may be selected as per IS: 1548 (Current) by the Employer’s representative from
amongst the raw materials and manufactured components of equipment and got tested in the approved laboratory. In case samples so selected fail to meet the standard specifications. The whole lot of manufactured components will be rejected and disqualified for use again for any of the Employer’s supplies.

ii) **Stage Inspection**

Employer reserves the right to carry out inspection at any stage of the process of manufacture and assembly for which all facilities will be provided by the Contractor. Before carrying out such inspection, necessary information will be given to the manufacturer by the Contractor.

iii) **Availability of Standard Specification Meters, Gauges etc. for Testing & Inspection.**

The manufacturer will maintain all relevant standards and codes of practice for manufacture, inspection and testing of components of the equipment ordered. He will also maintain a set of meters, gauges etc. as may be required for testing and inspection of components.

17.0 **Inspection Checks**

The details of the checks for various components are to be submitted by the contractor for Owner’s approval. However, some indicative checks on different items are given below which should necessarily form part of the quality assurance programme to be agreed with the Owner.

17.1 All plates above 20mm thickness to be ultrasonically tested for laminations. Shaft forgings and castings to be checked for hardness, microstructure and ultrasonic testing in addition to check for chemical and mechanical properties.

17.2 Following minimum NDT requirements to be ensured for welds:

i) Butt welds: 10 % Ultrasonic / Radiographic and 100 % Magnetic particle

ii) Fillet welds: 10% Magnetic particle
SPECIFICATION FOR MOTORISED VIBRATORY FEEDER
(600 TPH)

1.1 QUANTITY ------ 2 (TWO)

1.2 LOCATION _____ Below 50 te transfer hopper to feed tripper conveyor C2

1.3 BASIC PARAMETERS

1.3.1 Capacity --- a) Nominal 600 tph
                 b) Variable 200 – 800 tph

1.3.2 Feed Material --- a) ROM Coal containing Shale & Sand Stone up to 20 %
                        b) Bulk Density – 0.8 to 1.1 Te/Cubic meter
                        c) Moisture Content --- 7 to 10 % inherent but there may be appreciable surface moisture during rainy season.
                        d) Hardness -- Up to 1200 kg/ Cm²
                        e) Size (Max) -- 100 mm nominal

1.3.3 Angle of Installation -- 0 to 8° to the horizontal

1.3.4 Equipment Size -- a) Trough Width
                        To suit maximum feed size & capacity
                        ( Hopper outlet 1200mm X 1200mm )
                        b) Overall length – 2500 mm

1.3.5 Free fall height --- 1 Meter when empty

2.0 The feeder shall be suitable for uniform flow of non-abrasive to fairly abrasive material such as coal containing shale and sand-stone up to 20 %. It shall be able to take maximum lump size of up to 250 mm. The feeder should be robust enough to take the impact of the lumps from the stipulated free fall height.

The feeder shall be suitable for continuous operation for 3 shifts per working day and 330 days per year. The design of the feeder should be such that it can be operated for all the 24 hrs for 15 days, if required. It should meet the performance parameter with type of ROM coal indicated. It should be able to start in fill load condition. The feeder may be required to operate in every dusty atmosphere. The ambient temperature may vary between 40 °C and 50 °C and relative humidity may be up to 100%
3.0 The feeder shall be sturdy and robust in construction to withstand the worst duty conditions and at the same time give un-interrupted efficient operation. It shall have inherent design characteristics like rugged construction, low power consumption, wearing surface, low maintenance, variable rate control, acid resistant paint. Etc. The equipment shall be complete with all necessary accessories required for its efficient operation. In general, it shall have the following features,

3.1 Stroke Length

The equipment shall be linear Motion type with long stroke and low frequency to give required output. Mounting springs shall be of high quality Chrome Steel.

3.2 Trough

The trough and trough frame shall be rugged enough for the duty requirement and shall be designed for easy assembly and dis-assembly. The trough and trough frame shall be of high tensile steel and shall be provided with a replaceable abrasion resistant linear plate. The method of fastening the beam carrying the drive mechanism, to the Trough must be such that there must not be any possibility of loosening of this beam (Welding is not permitted).

3.3 **Drive Mechanism**

This may consist of two shafts fitted with single or twin vibrators. The vibrators may consist of two shafts journalled between heavy duty self aligning spherical roller bearing with a precision tolerance and fitted with unbalanced mass. The bearing used shall specially designed for vibratory machines only and shall be of 223 series. It shall be of SKF or FAG make. The shafts shall be geared together to rotate in opposite directions at a constant speed. The arrangement is to ensure linear motion from the vibrating mechanism. Any other equivalent design of vibrating mechanism to provide linear motion may be also accepted such as using two unbalanced motor exciters etc. The gears shall be housed in a casing with oil bath for automatic lubrication. The casing shall be provided with suitable seals to prevent ingress of dust and moisture.
The Vibrator shafts shall either be directly coupled or through V-belts to the motor. The vibrator shall be fitted below the feeder pan and shall have low HP to weight ratio so as to permit use of small motors to drive the eccentric weight at the optimum frequency for a specific application. The bearings shall be grease lubricated and housed in dust and moisture proof enclosure with combination of labyrinth and V Ring seals. Where unbalanced Meter Exciters are used, they must have IP 65 degree of protection (with Certificate).

3.4 **Low Noise Level :**
The feeder shall have quick starting, smooth stopping features and shall operate at an extremely low noise level. With the tray empty the noise level shall be under 80dBA within three feet of the units.

3.5 **Installation:**
The feeder shall be easily adoptable to almost any installation requirements. Feeder shall be supported from below. The suspension spring system shall be designed to provide maximum isolation of vibration. The design shall ensure transmission of spurious vibration into surrounding structure to minimum.

3.6 **Lubrication:**
The equipment shall be provided with centralized lubrication system with provision for manual lubrication also.

3.7 **Motor**
It will be suitable rating, high torque continuous rating, TEFC, Squirrel Cage Induction motor as per IOS 325 (Current) with Class – F Insulation and Horizontal shaft. The operating voltage of the motor will be 440 Volts, 3 phases, 50 Hz.

Motor will be complete with Cable Entry Box with glands suitable for PVC Insulated, PVC Sheeted, Armored cable of withstanding + _ 3% fluctuation in frequency. It shall have IP %: 55 protections.

3.8 **Starter :**
Contractor starter push button operated having current rating suitable for the above motor. The Contractor shall be in sheet steel enclosure with IP : 55 protection complete with the following ;
a) Auxiliary Contacts, 2 No and 2 NC for remote and sequence control with incoming and outgoing
b) Thermal overload and under voltage protection of suitable rating and with single phasing protection feature
c) Switch fuse unit with HRC fuses of suitable rating for short circuit protection.
d) Control coil Voltage 230 Volts AC
e) Cable glands suitable for PVC Insulated. PVC Sheathed Armoured, with Aluminum Conductor.
f) Necessary indicating lapse retarding availability of power shall also be available
g) Suitable earthling lugs(two nos.) shall be provided on the body of the sheet steel enclosure
h) Ammeter Selector switch for feeders above 30 KW

4.0 COMPLIANCE WITH STANDARD:
The design and construction of the equipment shall conforms with the IS : 12401 or equivalent international standard and up to date engineering practices.

5.0 TECHNICAL DETAILS REQUIRED WITH THE OFFER:
The offer shall be complete with the following failing which it may be treated as incomplete and passed over:
a) Types, Size and Make :
b) Make :
c) Capacity (TPH):
d) With and length of Trough :
e) Motor Power (KW) and other details including make and degree of protection
f) Starter details including Make
g) Range of Variable stroke
   length with corresponding capacities
h) Method envisaged for achieving the variable output
i) Weight of Feeder:
j) Details of replaceable wear resistant linear in the Trough
k) Type/size/Make of Bearing and expected life, bearing number
l) Type of Clearance adopted for Bearing
m) Type of Seal
n) Ratio of operating scale ration to the gravitational acceleration
o) Methods of installation of feeder
p) Materials offered for main frame and through, linear etc. including their ultimate tensile strength in Kg./Sq.Cm % of elongation and Brinell Hardeners number.
q) Drawings
   I. General arrangement dimensioned drg. of motorized vibratory feeder with motor
   II. Feeder Suspension arrangement drawing
   III. Drive arrangement details
   IV. Vertical static load at each support
   V. Vertical and horizontal dynamic load at each support
   VI. Spring deflection on each supporting point
      r) Method of limiting resonance vibration
      s) Resonance r.p.m. range during start and stop
      t) Maker’s descriptive Pamphlets
      u) Detail equipment specifications with constructional features.
   V) The following additional information to be furnished in case of unbalance meter emitters:
      I. Degree of protection IP:65........Yes/No.
      II. Run-up time..................................Sect.
      III. Static Moment
      IV. Centrifugal force
      V. Weight per Exister___________________-
      VI. Dimensional and Sectional arrangement
      VII. Drawing of unbalance Motor Exeter to be submitted with Offer indicating the Make Method of adjusting static Moment (and hence, vibration amplitude). This must be infinite variation within the total range.

6. **SPANERS:**
6.1 **Fast Moving Spares:**
   Separate item-wise price should be quoted for fast moving spares required for one year consumption. If the spares do not get consumed within a year, then
purchaser will have an option to sell back the spares to the supplier and realise capital & interest on the capital that has remained idle.

6.2 **Slow Moving Spares:**

List of Slow Moving Spares with their prices item-wise should be included by the supplier for a period under warranty. The purchaser will have an option to sell back the spares to the supplier and realise capital & interest on the capital that has remained idle.

6.3 **Insurance Spares:**

List of insurance spares which are required to be kept as standby to meet eventuality during life time operation of the equipment, should also be indicated.

7.0 **DRAWING AND MANUALS:**

7.1 **Drawing:**

One set of reproducible transparency with 3 sets of prints shall be supplied with 6 (six) weeks of place of order

a) General Arrangement is drawing and other sub assembly drawing showing all relevant dimensions with Sectional Elevation and End view, mounting details, load data etc.

b) Drawing showing foundation arrangement and installation details

c) Wiring diagram showing Terminals and External connections.

7.2 **Instruction and Spare Parts Manual:**

Six sets of instruction manual, bills of material, all technical literatures and descriptive bulletins of all equipment shall form part of spare of supply and shall be submitted with 6 (six) weeks of placement of order. This manual should contain interalia, guidelines for operation, installations, commissioning, running maintenance schedule, and over-hauling schedule. Six sets of Spare Parts manual shall also be supplied showing already the parts, location, code number etc.

8.0 **SPECIAL TOOLS AND TACKLES:**

The supply of equipment shall be complete with 2 sets of tools and tackles required for assembly/dis-assembly of the equipment of ensure smooth erection, commissioning and future maintenance.
9. **Inspection and quality control before dispatch:**

9.1 **Inspection and Quality Control Before Despatch**

i) **Special Material**

The manufacturer should furnish during inspection without extra charge test certificates covering mechanical properties and chemical composition for special raw materials used including that of liners. The certificates should be from the accredited testing laboratories like CMERI, Dhanbad, NPL, New Delhi, etc. If considered necessary, samples for material may be selected as per IS : 1548 (Current) by the Employer’s representative from amongst the raw materials and manufactured components of equipment and got tested in the approved laboratory. In case samples so selected fail to meet the standard specifications, the whole lot of manufactured components will be rejected and disqualified for use again for any of the Employer’s supplies.

ii) **Stage Inspection**

Employer reserves the right to carry out inspection at any stage of the process of manufacture and assembly for which all facilities will be provided by the Contractor. Before carrying out such inspection, necessary information will be given to the manufacturer by the Contractor.

iii) **Availability of Standard Specification Meters, Gauges etc. for Testing & Inspection.**

The manufacturer will maintain all relevant standards and codes of practice for manufacture, inspection and testing of components of the equipment ordered. He will also maintain a set of meters, gauges etc. as may be required for testing and inspection of components.

9.2 **Testing & Inspection**

The details of the checks to be carried for various components are to be submitted by the contractor for Owner’s approval. However, some indicative checks on different items are given below which should necessarily form part of the quality assurance programme to be agreed with the Owner.

9.2.1 All plates above 20mm thickness to be ultrasonically tested for laminations.

9.2.2 Shaft forgings and castings to be checked for hardness, microstructure and ultrasonic testing in addition to check for chemical and mechanical properties.

9.2.3 Following minimum NDT requirements to be ensured for welds.

i) Butt welds : 10 % Ultrasonic / Radiographic and 100 % MP/ DP test

ii) Fillet welds : 10% Magnetic particle/ DP test
10. **Delivery period**:

Shortest possible delivery period should be indicated by the tenderer.

11. **TECHNICAL DETAILS REQUIRED WITH THE OFFER**:

The tenderer shall include following details along-with each copy of their offer (in triplicate) failing which the offer shall be treated incomplete and may be passed over. These shall be in addition to any other details as asked for else-where in this specification.

11.25 **Capacity**:

11.25.1 Rated capacities of the crusher in tones/hour at indicated feed size and product size.

11.25.2 Capacities at different product sizes in tonnes/hour at indicated feed size and different product sizes referred above along with % of oversize and size of max lumps in the product.

11.26 **Drawings**:

11.26.1 Dimensional general arrangement drawing of complete crusher with motor along with relevant details viz. shaft diameter, roll diameter, roll length etc.

11.26.2 Foundation arrangement drawings and anchor bolts position of the crusher with motor. Impact allowance of crusher for crusher foundation design.

11.26.3 Roll construction details, diameter and width.

11.26.4 Any special features incorporated to ensure uniform product size.

11.27 **Weight**:

Weight of crusher with motor, weight of the single heaviest part of the crusher.

11.28 **Bearings**:

Type and size of bearings, make of bearings.

11.29 **Materials**:

Material offered for crusher shaft, roll etc. including their tensile strength in Kg/sq.cm. elongation % and Brinell hardness number.
11.30 **Power Requirement** :

Horse Power absorbed at the crusher shaft.

11.31 **Drive arrangement details.**

11.32 **Construction features in detail to highlight the different functions as described in clause – 3 above including the following specific features :**

- vii. Gap setting arrangement for rolls.
- viii. Power distribution arrangement for drive unit.
- ix. Details of fast acting retractable device.

11.33 **Electrical (Separate price shall be quoted)** :

Details of motor, make, type frame size, rated current, starting current, starting torque, rated torque, pull out torque and any other relevant details shall be indicated in the offer. All relevant technical details including make, type, size etc. for the starter shall be furnished. Manufacturer’s descriptive technical pamphlet for motor and starter shall be furnished.

11.34 **Life** :

The tenderer shall clearly indicate minimum guaranteed roll life at rated capacity.

11.35 **Makers descriptive pamphlet.**

11.36 Calculation in support of power required for the crusher.

11.37 Calculation in support of capacity of the crusher, diameter of the roll.

12. **Informations to be supplied along with the drawing after placement of order.**

Manufacturer will supply six copies of drawings for approval showing therein all relevant details including that covered vide para 11.1 to 11.8 above, before start of fabrication.

13. **GUARANTEE :**

The tenderer shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated in this specification. This guarantee shall be for a minimum period of 12 months from the date of commissioning or 24 months from the date of receipt by consignee, whichever is earlier.
14. **PAST PERFORMANCE**:  
The tenderers are required to furnish the following details in support of their successful past experience in manufacturing of this equipment.

14.1 Name and address of the organizations who are using similar make, type and capacity of crusher.

14.2 Material handled including maximum feed size and product size.

14.3 Year of supply of Crusher, with order number and date (Minimum three different orders to be indicated).

14.4 User’s performance certificate, if any.

14.5 Capability of the firm in manufacturing of such equipment with Annual turn – over for last 3 years.

14.6 Various facilities availability for such work.

14.7 Inspection and quality control facilities available with the firm.

15. **DEVIAITION**:  
Any deviation from NIT specification must be brought at one place to facilitate proper evaluation.

16.0 **Guaranteed percentage availability**:  
The equipment should be guaranteed for a minimum of 90% availability during 12 months from the date of commissioning.

The following formula will be adopted to calculate percentage availability.

\[
\frac{(Total\ shift\ hours - breakdown\ hours - maintenance\ hours)}{(Total\ shift\ hours)} \times 100
\]

(Total shift hours=8x no of shifts operated in 12 months including those on scheduled holidays)
1. BASIC PARAMETERS

a) Number of Silo: (One) silo complete with all fittings and fixtures (Arch breakers, flood gates, loading gates, Pre-weigh hopper, hydraulics, power pack, compressor, etc)

b) Capacity: One wagon per minute

c) Silo capacity: 4000 t

d) Variable capacity of RLS: Upto 5500 TPH

e) Material to be handled:
   i) Material: Crushed coal containing shale and sand stone up to 30%
   ii) Size: (-)100mm
   iii) Moisture content: Inherent moisture 7 to 10% during rainy season there may be considerable amount of surface moisture in the coal and this may be up to 20%.
   iv) Bulk density: 0.8 t/m$^3$ for volume calculation & 1.15 t/m$^3$ for load calculation

f) Chute travel distance: As per drawing given elsewhere

g) Silo load conveyor: Belt width 1400 mm with 3 rolls of equal length and troughing angle of 35$^\circ$ at a speed of 3.0 m/sec

h) Silo side slopes: As per test report

i) Number of outlets: 2 (with two pre-weigh hoppers)

j) Inside Diameter of Silo: 18 m

2. SYSTEM DESCRIPTION

The rapid load out system is a facility for flood loading of wagons. The loading station shall be located over rail track for transportation of coal. The train/ rake consists of 58 wagons (maximum) of 60 t capacity each and will be loaded at the rate of approximately 5500 TPH. The train will be hauled by diesel locomotive and will run under the loading point at a steady speed of 0.8 km/hour. Each wagon will take one minute to pass under the loading point. The system envisages loading of 60 t capacity wagon in about one minute. System consists of a 4000 t capacity silo having two openings for loading. Each opening is provided with four gates below the silo over one pre weigh hopper assembly. Hydraulic system is envisaged for the operation of Flood loading gates and telescopic chutes.
The rapid load out system as envisaged in this proposal shall have arrangement such that pre-weighed quantity of coal is discharged into each wagon and the individual weighment is recorded automatically when the weigh system is put in auto mode.

3  OPERATION

When the presence of rake is detected near silo, the mode selector is in automatic position, gate to be used for loading is selected, the telescopic chute is in position and permissive signal is given to the system for loading, the corresponding silo outlet gate shall open and then pre-weigh hopper will start filling. As the weight in the pre weigh hopper shall reach in the neighbourhood of 60 t, two gates will close while remaining two will close partially for trimming the hopper to the desired weight. When set point is reached the partially opened silo outlet gates shall close and weigh hopper ready light will come on. As soon as the first wagon comes under selected loading gate, the swing chute shall be lowered automatically and the flood loading gate shall open. The material is loaded into the wagon and the flood loading gate closes automatically as soon as weigh hopper is empty. Now the silo outlet gates will open suitably for filling the pre weigh hopper. As the 2\textsuperscript{nd} wagon approaches the silo outlet gates shall start closing and by the time they are closed, full 60 t of material is discharged into the pre weigh hopper and is ready for filling the second wagon. In this manner the weigh cycle continues automatically until the full train is loaded.

After the loading operation is completed the chute shall go up after a pre set time. The weighing system shall also incorporate digital display system with suitable printer for printing of date, time weight of each weighment and net weight of coal weighment per operation of rake loading.

One uses a pre-weigh hopper of capacity 72 t which is filled by guillotine gate provided above the hopper and below the silo discharge pockets. The hoppers are provided with load cells to weigh the material loaded in the hopper while gate is opened and the guillotine gates are closed immediately after filling of pre weighed quantity in the hopper this is done automatically.

4  OPERATION OF CHUTE GATE

Pre weigh hopper along with chute is provided with high speed load out to load wagons. The facility has three functions

4.1 The loading chute comes down from the clear position to the load position under the load out bin.

4.2 The opening and closing of the 1525 mm x 1525 mm size gate at the bottom of the bin. The chute will be capable of handling semi solid / slurry material in rainy season. The equipment will be required to operate 18 hours a day and 330 days a year, but the design will be such that it can be operated 24 hours a day and 365 days a year. The surrounding may be quite dusty and surface temperature may vary from 4°C to 50°C and relative humidity up to 100%.
5.0 OVERHEAD SILO

5.1 GENERAL FEATURES:

The silo shall be of R.C.C. construction and designed to take all the loading as required for the system. Necessary structural work shall also be provided to house the lift, stairs etc. The structural work shall also include necessary platforms, ladders/stairs, etc.

The silo shall be designed on the basis of “Mass Flow” concept, so that chances of bridging, arching, rat-holing at silo outlet is minimised. However, because of wide fluctuations in the condition of the run of mine coal being fed into the silo, due to seasonal impurities etc. there may be possibility of arching or bridging. To overcome the situation a pneumatic arch breaking device (as elaborated elsewhere) shall also be included. Adequate number of holes shall be provided around the silo at suitable locations. The holes shall be fitted with discharge tubes with flanges for quick and easy mounting of pneumatic arch breaker. These holes shall also be utilised for injecting inert gas inside silo for fire fighting purposes. The sloping sides of the silo shall be provided as per test report for free flow. The silo shall be lined with 8 mm thick stainless steel of 409M grade liner up to the top of the conical portion of the silo from the bottom openings. The width of the SS Liner shall not be more than 1000mm at top end of cone and the gap between the liner and concrete shell shall be filled with lean concrete. Sufficient weldments shall be provided at the joints so that liner does not come out. Vertical portion of the silo wall shall have ferrosite lining of 25 mm minimum thickness up to one (1) metre above the highest surface of vertical wall coming in contact with coal.

5.1 LEVEL INDICATION INSIDE SILO

The level indicators provided shall monitor –

i) Continuous level of coal in the silo

ii) Pre determined high coal level in the silo which will automatically stop the silo in feed conveyors.

iii) Pre-determined intermediate level.

iv) Pre-determined low level in the silo, which will automatically close the silo outlet gates. This is to prevent damage to the silo outlet gates. The gates shall remain closed and inoperable until a pre determined intermediate level is reached. This shall be preferably ultrasonic type complete with sensor, transmitter and limit controllers, etc and audio visual signalling system for different levels.
5.3 PNEUMATIC ARCH BREAKER

The Arch Breaker shall be compressed Air operated. A separate air compressor shall be supplied for operation of the Arch Breaker.

The Arch Breaker shall be designed to suit the duty requirement and shall discharge air into the coal with sufficient energy to break the arch. The arch breaker shall be complete with compressed Air Cylinder, quick release valve etc.

Adequate number of holes around the silo at suitable locations with cast in tubes/pipes with blind flanges shall be provided to facilitate connection to the arch breaker installed at suitable location.

4.4 AIR COMPRESSOR

This shall be electrically driven, compact preferably horizontal air receiver mounted. The compressor shall have sufficient piston displacement and operating pressure to suit the duty requirement of the arch breaker.

The compressor shall be complete with pressure gauge, safety valve, pressure switch, non-return valve, air piping/hoses for connection to arch breaker, drives etc. The operation of the compressor to charge the Arch Breaker shall be from the main control room only.

5.5 LOAD OUT SYSTEM

5.5.1 SILO OUTLET GATES

At the silo bottom, there shall be large opening for discharge of coal to the pre-weigh hopper. Silo opening shall be fitted with four (4) quick acting hydraulically operated guillotine type double blade knife edged gates. The gates shall preferably be mounted on rollers for easy movement. The gate support system shall be of sturdy construction and designed to take impact during quick discharging operation. The gates while opening shall discharge coal into the pre-weigh hopper.

The operation cylinders shall also be provided with positioners to provide a reduced feed rate at near balanced condition at the end of the operation to achieve a precise cut off at the desired weight. The complete loading of pre weigh hopper shall be completed in approximately 15 sec at an average total discharge rate of 14,400 TPH total for all the four gates.

As the loading of pre-weigh hopper up to 60 t is complete, the silo outlet gates will close. The silo outlet gates shall automatically repeat operation (i.e. quickly close and open) to clear any trapped material between gates.
6.0 PRE-WEIGH HOPPER

There shall be two (2) pre-weigh hoppers, one each installed at silo bottom opening each having about 1.2 times the wagon payload capacity. The pre weigh hopper shall be of mild steel construction and designed to take shock and impact loads during filling and discharging operation.

The inside of the pre-weigh hoppers shall be lined with stainless steel liners of 409M grade. The slopping sides of the hopper shall be as per test report for free flowing and lined with 409M grade stainless steel. The hopper shall have large gate area to ensure maximum discharge rate for clearing of the weigh bin on each operation cycle and matching with the train speed and size of the individual unit train bottom discharge wagons.

The pre-weigh hoppers shall be supported on high quality strain gauge dual bridge load cell assemblies forming into a weigh bridge system with twin connectors.

The load cells shall have an overload protection of at least 150% or more of rated capacity and structurally safe to 300% of rated capacity. The load cells shall be housed in temperature control shrouded complete with insulation. They shall have all necessary assembly, hardware for smooth operation of the load out system. There shall also be an arrangement for setting the weight in pre weigh hopper from 55 to 62t.

6.1 PRE WEIGH SYSTEM – TEST WEIGHTS AND ACCURACY

i) For testing and calibrating the pre weight hopper system, test weights shall be supplied with the system. These test weights shall be approved by the Weights and Measures Department.

ii) The test weights may be integral with the weigh system and shall provide for easy calibration of the weigh system in shortest possible time after each rake loading.

iii) The weigh hopper system shall be capable of pre weighing coal for each wagon to an accuracy of + 0.1 % of the set point.

iii) The weigh bridge for the pre-weigh hopper system shall have check rods and brackets of suitable design.

6.2 FLOOD LOADING GATE

Each of the pre weigh hopper shall be fitted with one number flood loading gate of suitable size and design for discharging coal into wagons from pre weigh hopper. The flood loading gate shall be operated by hydraulic cylinders and shall provide maximum discharge rate for filling the wagons moving at a speed of 0.8 km/hr in approx. 35 seconds.
The flood loading gate shall be knife edged guillotine type. The gates shall be designed to withstand the load and impact during loading operation. The gates shall be constructed on mild steel, suitably stiffened and provided with TISCRAL or equivalent liner plates on the sides of the gate exposed to wear. The gate shall be of suitable design to avoid spillage of material when gate being in closed position. Also there shall be provision for automatic operation of gate to give passage to any trapped material so as to ensure perfect closing of gates.

6.3 FLOW CONTROL GATE

This gate will be located at the bottom of the chute and will have a nominal 1525 mm x 1525 mm internal opening and will be of curved blade non jamming type design. It will have the following specific features.

i) The gate wall will be of 12 mm mild steel plates with 10 mm abrasion resistant steel liner (TISCRAL) to 220-240 BHN plug welded.

ii) The curved blade will be 25 mm mild steel plate with 5 mm type 304 stainless steel top liner.

iii) The blade will pivot on a shaft supported by two flange hearings with external lubrication fittings.

iv) Actuation will be by two hydraulic cylinders.

v) The gate opening can be varied between fully close and fully open position, if required. The gate position feedback will open position, if required. The gate position feedback will be provided by position indicator connected to the gate blade pivot shaft.

7. Swing Chute

The swing chute arrangement with bottom discharge gate should have nominal 1525 x 1525 mm opening and have the following specific features:

i) Chutes wall constructed of 12 mm mild steel plate with abrasion resistant lining steel plates provided at places where coal flow is expected.

ii) The Chutes should pivot in the direction of train travel. The pivoting action will be such that positive control over positioning of chute with respect to the wagon is possible, so offering quicker, safer response in emergency conditions requiring chute retraction to its storage position.

iii) Chutes should have necessary replaceable urethane seal system to minimise dust.
iv) Necessary arrangement will be provided to give automatic retraction of chute if contract with forward moving wagon or locomotive is made.

v) The chute will have shear section such that in the event of a roll back by the locomotive or a wagon and the chute not retracting in time, the shear bolts would be cut and the lower gate section will merely drop into the wagon safely without any damage to other parts of the chute gate system.

vi) A crushable section will be provided at the lower most section of the chute so that any wagon hitting this section will crush it without crushing any other damage to the chute. This crushable section will be replaceable.

vii) The chute will be actuated by heavy-duty hydraulic cylinder cushioned at both ends.

viii) The chute will be capable of being raised to clear position in fully loaded condition also.

8.0 HYDRAULIC SYSTEM

8.1 HYDRAULIC POWER PACK

Two hydraulic systems shall be supplied for operation of each of the silo outlet gates, the flood loading gates and the chute system. The system shall be identical to maximise reliability and inter-changeability. The rating of all hydraulic equipment /component shall be well above the duty for which it is required and shall be suitable for operation in tropical climate and dusty atmosphere.

Each of the hydraulic system shall have its own power pack and each power pack shall incorporate dual hydraulic pump (which will provide immediate back up in the event of pump failure) with electric motor, fluid supply tank fitted with necessary pressure and control equipment, filters, gauges, pipe/ high pressure hose work etc.

Each of the fluid supply tank shall have ample capacity appropriate to its duty. It shall be fabricated in mild steel and provided with flanged connections for the supply and return pipes. Provision for complete drainage shall be made and flanged apertures for sludge removal shall be incorporated. All pipes returning fluid to the tank shall terminate at a level sufficiently below the fluid surface to prevent aeration. Each suction pipe shall be fitted with a high efficiency filter positioned well below the fluid surface to prevent vortex formation. Preferably the pump may be provided with positive suction head by elevating the tanks above the pumps. The tank shall be equipped with the following gauges etc:-

a) Sight glass giving clear visual indication of fluid level
b) Low fluid level device with visual and audible alarms.
c) Temperature sensing device with visual and audible alarms.
d) Pressure gauges.
All hydraulic pipe/hose work shall follow the shortest practicable route in neat, straight runs, readily accessible for maintenance yet sited in a position which presents least risk of mechanical damage. Pipe work in unavoidable exposed position shall be effectively protected and all pipe work shall be adequately supported. Electric motor shall be squirrel cage induction motor suitable for 415+10%.

8.2 HYDRAULIC ACCUMULATOR

Each of the hydraulic system shall also incorporate back up protection in the form of hydraulic accumulator, so that in the event of power failure, or pressure failure closing of the gates can be achieved. The accumulator shall have sufficient capacity for a normal open/close of silo outlet emergency or flood loading gate. The accumulator system shall also include necessary hydraulic/electric control with audio visual alarms. Hydraulic accumulator control should have pressure release valve to be controlled from console.

8.3 HYDRAULIC CYLINDERS

These shall be of suitable bore and stroke double acting cylinders with cushioned ends. Hydraulic seals shall be suitably selected to prevent ingress of dust and moisture and to provide for longer life.

9.0 DUST CONTROL BETWEEN SILO OUTLET GATES AND PRE-WEIGH HOPPER.

The loading rate at this zone being tremendously high may generate lot of dust. Suitable flexible dust cover may be provided between the silo outlet gates and pre-weigh hopper for air vent without release of dust. If required the coal dust may be extracted to finally discharge the clean air into the atmosphere.

9.1 DUST CONTROL DURING WAGON LOADING

A sufficient number of precision and anti clog nozzles made of stainless steel shall be fitted at suitable places at the loading point for suppression of dust during loading operation. The nozzles shall provide high pressure atomised sprays of water or/water mixed with suppressant for effective suppression of coal dust.

The dust suppression system shall be so interlocked that it operates only when the loading operation is on. The suppression system shall be complete with necessary piping, pumps, fittings and fixtures etc. The system may be part of the total dust suppression system as per scope of this tender with one standby pump. The pumps shall be located at the base of silo with all piping connections to dust suppression system. The pumps shall be connected to main water supply pipeline.
10.0 MAINTENANCE, MONORAIL HOISTS AND CHAIN PULLEY BLOCKS

Necessary Monorail Electric hoist and Chain Pulley blocks of adequate capacity at suitable points shall be provided in respective floors and on silo top and intermediate floors of sampler house for hoisting and lowering of equipment/components.

11.0 FIRE FIGHTING SYSTEM

In addition to provision of hydrants at silo loading complex, an additional hydrant pipe shall be laid from ground level to the top of silo. This pipe shall be connected to a circumferentially laid pipe at silo top with two outlets to flood the silo inside in case of fire in stored coal. The control valve of this pipe shall be at ground level.

12.0 Inspection and Quality Control

12.1 Special material

The manufacturer should furnish during inspection, without extra charge, test certificates covering mechanical properties and chemical composition for special raw materials used including that of liners. The certificates should be from the approved testing laboratories like CMERI-Dhanbad, NPL-New Delhi etc. If considered necessary, samples for such material and components may be selected as per IS: 1548 (current) by the employer’s representative from amongst the raw materials and manufactured components of equipment and tested in the approved laboratory. In case samples so selected fail to meet the standard specifications, the whole lot of the manufactured components shall be rejected and disqualified for use again for any CIL supplies.

12.2 Stage Inspection

The Employer reserves the right to carry out inspections at any stage of the process of manufacture and assembly for which all facilities will be provided by the manufacturer. Before carrying out such inspections, necessary advance information will be given to the manufacturer.

12.3 Availability of standard specification Meters, Gauges, etc. for testing and inspection

The manufacturer will maintain all relevant standards and codes of practices for manufacture, inspection and testing of components of the equipment ordered. He will also maintain a set of meters and gauges etc. as may be required for testing and inspection of components.

12.4 Checks during inspection:

The details of the checks to be carried for various components are to be submitted by the contractor for Owner’s approval. However, some indicative checks on different items are given below which should necessarily form part of the quality assurance programme to be agreed with the Owner.

12.5 All plates above 20mm thickness to be ultrasonically tested for laminations. Shaft forgings and castings to be checked for hardness, microstructure and ultrasonic
testing in addition to check for chemical and mechanical properties

12.6 Following minimum NDT requirements to be ensured for welds:

i) Butt welds : 10% Ultrasonic / Radiographic & 100% MPI

ii) Fillet welds : 10% Magnetic particle
BELT WEIGHERS

1. Basic Parameters

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>ii)</td>
<td>Max. lump size (mm) : 200MM.</td>
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<tr>
<td>iii)</td>
<td>Bulk density (t/m³) : 0.8 – 1.15.</td>
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<tr>
<td>iv)</td>
<td>Specific gravity : 1.6 – 1.65</td>
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<tr>
<td>v)</td>
<td>Percentage moisture : 20%</td>
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<tr>
<td>vi)</td>
<td>Angle of repose : 35º</td>
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<tr>
<td>vii)</td>
<td>Ambient temp. (° C):</td>
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<tr>
<td></td>
<td>Maximum : 0ºC : 4ºC</td>
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<tr>
<td>viii)</td>
<td>Conveyor data</td>
</tr>
<tr>
<td></td>
<td>Conveyor description : 3C&amp;4C,1200 TPH</td>
</tr>
<tr>
<td></td>
<td>Belt width : 1400 mm.</td>
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<tr>
<td></td>
<td>Conveyor length(m) : As per system layout</td>
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<tr>
<td></td>
<td>Belt speed (m/sec) : 3.0/2.85</td>
</tr>
<tr>
<td></td>
<td>Inclination of Belt : Horizontal</td>
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<tr>
<td></td>
<td>Type of take up : Gravity</td>
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<tr>
<td></td>
<td>Troughing angle : 35º</td>
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<tr>
<td></td>
<td>Carrying idler spacing : 1.0 m</td>
</tr>
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<td>ix)</td>
<td>Location/type of weigher : Outdoor/multi idler</td>
</tr>
<tr>
<td>x)</td>
<td>Working condition : Dusty and Moist.</td>
</tr>
<tr>
<td>xi)</td>
<td>Voltage available : As per requirement</td>
</tr>
</tbody>
</table>

2. Duty Condition

Belt weigher shall be of out door type. The equipment is to be installed on a horizontal portion of a belt conveyor and it will record the weight of coal moved through the conveyor system within permissible accuracy of ± 0.5%. The weight measured will be displayed and also printed on cards. The equipment should have inherent design features to work in dusty condition and fluctuating quantity of material coming through the belt conveyor system. The belt weigher should have facilities of digital display board, daily chart recorder for rate of flow, feed rate indicator, TPH and totaliser for automatic recording and displaying of total material handled. The reading of the belt weigher should be displayed clearly in the main control room. The total quantity despatched & the balance quantity available in ground bunker should be clearly displayed in the main control room.
The overall unit should be robust, compact, simple and easily installable. It should be locally controlled as well as remotely controlled from the control room. The unit should not require constant attention, regular maintenance, or frequent calibration, and it should have a voltage stabiliser to take care of any voltage fluctuations. The sensor will be of suitable type and design to guarantee the desired weighing accuracy. A speed-sensing device will be provided with the systems as required. The display of quantities should be available locally as well as in the control room. Signals from the belt weighers installed with in-feed conveyors to the bunker and loading conveyor to the silo will be fed to PLC to compare the in-coming quantity and out-going quantity and thereby getting the information regarding balance quantity available in the bunker.

3. **Constructional Features**

In general, the equipment should be robust in nature and have inherent design features so as to give satisfactory performance in adverse loading conditions also. The belt weigher will be microprocessor based electronic type. It will be complete with all accessories required for its successful operation in the stipulated duty condition. It will inter-alia have the following specific features.

3.1 **Weighing Frame & Sensors**

Sufficient care should be taken in the fabrication and alignment of the weighing frame, which is to be supported using anti-friction ball bearing linkages, leverages etc. so as to facilitate a smooth movement of the weighing frame in vertical plane. It will have strain gauge type load cell/pendulum resistance type load sensing and speed sensing device of proper design to ensure satisfactory result.

3.2 **Signal Conditioner/Integrator**

This forms the interface between the sensors and the control console. It incorporates the necessary multiplier integrator for the generation of speed signal and conversion of load signal into weight signal. The information about the speed of the conveyor is obtained from the speed-sensing device which is directly proportional to the belt travel. Since the control console in the case of electronic weighers is usually located at a place far away from the conveyor belt, it is desirable to transmit the load cell outputs after processing as a current signal rather than as a voltage signal. This is however, not applicable in the case of mechanical weighers.

3.3 **Rate Indicator**

The rate indicator is an automatic null balance potentiometer type servo indicator capable of accepting DC signals. The signal is further processed by necessary accessories and finally indicated by the position of the pointer of the potentiometer. This gives a measure of voltage produced by transducer and is indicated as rate of flow in the case of electronic weighers. It is however, not applicable for mechanical or other type of weigher.
3.4 **Totaliser**

This is a real time integrator. Sufficient care should be taken in designing of integrating element and the time function generator since the long term accuracy of the equipment depends upon the quality of the integrating element and the stability of the time function generator. This performs the function of totalising the quantity of material passed through it during a particular period of time, and the same can be recorded and numerically displayed.

3.5 **Calibration Set Up**

This is a set up for checking the operational accuracy of the system which incorporates all the functional blocks, in terms of a ‘Number’ usually known as the ‘cal-figure’. Initially, immediately after commissioning the system, the cal-figure could be evaluated and recorded, so, the cal-figures displayed at later date could be compared with initial figures and the necessary adjustment effected to bring back the system to the original condition. The provision of this system should be elaborated in detail. Alternatively, the weigher should be calibrated by a test chain. The range of accuracy should be from 50% to 120% of rated capacity of respective conveyor belt.

3.6 **Display and Operator Control Consoles**

The control console and display unit will be housed in a control room provided near the loading point. The weight indicator will be visual digital/analogue type and should be fully self-indicating. The indicator will be enclosed in dust and moisture proof housing and it should show at a glance the weight of material conveyed and also the rate at which material is being conveyed. The latter height should be such that it could be easily read from a distance. All the electronic circuitry of the weigher, as far as possible, should have printed card modular feature for easy replacement of defective control parts ensuring minimum down time of the equipment.

4 **Inspection and Quality Control**

4.1 **Special material**

The manufacturer should furnish during inspection, without extra charge, test certificates covering mechanical properties and chemical composition for special raw materials used including that of liners. The certificates should be from the approved testing laboratories like CMERI-Dhanbad, NPL-New Delhi etc. If considered necessary, samples for such material and components may be selected as per IS : 1548 (current) by the employer's representative from amongst the raw materials and manufactured components of equipment and tested in the approved laboratory. In case samples so selected fail to meet the standard specifications, the whole lot of the manufactured components be rejected and disqualified for use again for any CIL supplies.

4.2 **Stage Inspection**

The Employer reserves the right to carry out inspections at any stage of the process of manufacture and assembly for which all facilities will be provided by the manufacturer. Before carrying out such inspections, necessary advance information
will be given to the manufacturer.

4.3 **Availability of standard specification Meters, Gauges, etc. for testing and inspection**

The manufacturer will maintain all relevant standards and codes of practices for manufacture, inspection and testing of components of the equipment ordered. He will also maintain a set of meters and gauges etc. as may be required for testing and inspection of components.

5.0 **Checks during inspection:**

The details of the checks to be carried for various components are to be submitted by the contractor for Owner’s approval. However some indicative checks on different items are given below which should necessarily form part of the quality assurance programme to be agreed with the Owner.

5.1 All plates above 20 mm thickness to be ultrasonically tested for laminations. Shaft forgings and castings to be checked for hardness, microstructure and ultrasonic testing in addition to check for chemical and mechanical properties

5.2 **Following minimum NDT requirements to be ensured for welds:**

   i) Butt welds : 10% UT / RT and 100 % MPI
   ii) Fillet welds : 10% MPI

6.0 **Compliance With Standards**

All components, material and equipment used will comply in general, with relevant Indian / International Standards and in particular to the specifications furnished. Acceptance test will be as per relevant standard be conducted out by manufacturer and test certificate will be furnished with equipment.
BELT CONVEYORS

1. Scope Of Supply

The scope of supply will include the complete conveyor system with different accessories in the quantities required in terms of the detail specifications read with the different drawings and schedules of conveyors forming part of this Tender specification. It shall, inter-alia include the following:

   a) Motors
   b) Gearboxes.
   c) Couplings
   d) Idlers – carrying, return, impact self-aligning and transition.
   e) Pulleys
   f) Idler frames
   g) Conveyor frames.
   h) Stools for supporting conveyor frames.
   i) Bearings & Plummer blocks.
   j) Skirt plates.
   k) Decking plates.
   l) Belt cleaning devices.
   m) Hold back device.
   n) Electro-magnetic brakes.
   o) Pull chord switches.
   p) Belt sway switches.
   q) Zero speed switch/belt sequence switch.
   r) Tripper arrangement.
   s) Take up devices.
   t) Guards
   u) Starter
   v) Necessary structures.
   w) Any other accessories needed for successful operation of the conveyors to meet the system requirement.
2. Duty Conditions

The conveyors may have to work in most adverse working conditions like heavy dust, exposed to sun-light, with high surface temperatures up to 50 °C, in rain, in relative humidity up to 100% etc. The conveyor will operate on average for 15 hours a day over 330 days per year in general, but the design is to be such that it can be operated for all the 365 days a year and all the 24 hours a day, if required. The conveyors will be able to start in full load conditions. In case of dual drive system for the conveyors, if one drive fails, then the another drive will be able to take minimum 50% load.

The design of take-up shall be such that the tension can be achieved by adding RCC blocks on the frame. A box with filled up weight is not acceptable, there shall be provision for increase/ decrease of tension as per requirement during dynamic condition of the conveyor. The location of counter weight for take-up devices will be such that it should not be above any other conveyor. Motorised take-up may be offered alternatively.

There should be minimum clearance of 0.5 m between ground and the return belt throughout the length of the conveyor i.e., including tail end and discharge end.

The tail end of the conveyors will at least be 5.0 m behind the discharge point of the feeding chute. The discharge end of all the conveyors will be designed in such a way that scrap material at discharge end should fall in the discharge chute.

3.0 Power Unit

3.1 Power supply

6.6/0.440kV, 3-phase, 50 Hz.

3.2 Motor

TEFC induction motor of squirrel cage type, synchronous speed – 1500 rpm, insulation – class ‘F’ high torque, foot mounted integral type, with IP-55 protection as per IS 4961. The motor power rating for conveyors shall be minimum as indicated in the conveyor schedule.

The motor will be capable of giving rated out put without reduction in the expected life span operated continuously in the system having the following particulars:

<table>
<thead>
<tr>
<th>i)</th>
<th>Rated terminal voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 110 kW &amp; below</td>
<td>: 440 V, 3-phase,</td>
</tr>
<tr>
<td>- above 110 kW</td>
<td>: 6.6 kV, 3-phase,</td>
</tr>
<tr>
<td>ii)</td>
<td>Variation in voltage</td>
</tr>
<tr>
<td>- Variation in frequency</td>
<td>: ± 5% for 415 volt : ±10% for 6.6kV.</td>
</tr>
<tr>
<td>iii)</td>
<td>Frequency</td>
</tr>
<tr>
<td>- Variation in frequency</td>
<td>: 50 Hz.</td>
</tr>
<tr>
<td>-</td>
<td>: + 5%, -3%</td>
</tr>
</tbody>
</table>
The motor will be suitable for full voltage DOL starting. This will be capable of starting and accelerating to the rated speed along with the fully loaded driven equipment without exceeding the acceptable winding temperature even when the supply voltage is 80% of rated voltage throughout the starting period.

The locked rotor current will not exceed six times rated full load current subject to tolerance as given in IS 325.

Space heaters suitable for 240 V, 50 Hz, single phase supply system will be provided for motor above 30 kW capacity. For ratings below 30 kW, space heaters will be provided if it is meant for specific use in damp areas.

Suitable temperature detector for detection of winding and bearing temperature will be provided for all 6600 volt motors. These will be located at locations where high temperatures are expected during operation. The indications will be carried to the control desk.

Power terminal blocks will be suitable for receiving 6600/1100 volt grade aluminium conductor single layer armoured cross linked polyethylene insulated cable.

Two independent earthing points will be provided in accordance with IS 3043.

All motors will be provided with eye bolts, lugs or other means to facilitate lifting.

The design, manufacture, installation and performance testing will conform to the latest revisions of the Indian Standards or their equivalent IEC standards for the applicable motor type and rating, and to the latest Indian Electricity Acts, Indian Electricity Rules and IS 325.

4. **Conveyor Frame**

The conveyor frame will consist of ISMC 150 mm stringers connected by ‘N’ shaped cross bracing of ISA 65 X 65 X 8mm. Individual sections will be of suitable lengths to facilitate easy assembly at site without any match marks and without having any reference to left and right of the conveyor. At the same time top and bottom idler frames when assembled on the stringer will have their position at right angles to the longitudinal axis of the conveyor. Provision will be made for jointing of sections with permitted play in the vertical plane of the order of 3 degree to 4 degree with nut and bolts system.

The conveyor frame will be complete with stools of size ISMC 100mm for supporting stringers. Holes for fixing the supporting stools will be drilled on stringer channel for intermediate structures. Stools for support of conveyor frame will consist of vertical supports with suitable bracings and base plate to enable fixing of stools on foundation. The height of the stools will be such as to give clearance between return roller and ground of at least 500 mm. The plates of the stools and ground will be suitably drilled for grouting. In case the return roller is located at the centre of the trestle, conveyor frame below the return idler shall be covered/ sealed by chequered plate of 3 m (1.5 m to the either side from the centre of the each trestle) to cover the gap below the return idler. Sufficient clearance between roller and
chequered plate shall be provided for cleaning.

5. **Idlers**

Idlers will be made of ERW tubes as per IS-9295 The diameter and thickness of roller tubes, spacing of idlers and the bearing bores for carrying idlers, return idlers, impact idlers, etc. should be mentioned clearly for different widths to suit the duty condition and will in all case conform to the following limits or requirements:

5.1 **Minimum tube diameters and thickness**

<table>
<thead>
<tr>
<th>Details</th>
<th>Belt Width – 1400mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Carrying Idler (mm)</td>
</tr>
<tr>
<td>OD of steel tube (mm)</td>
<td>168.3</td>
</tr>
<tr>
<td>Tube thickness (mm) - minimum</td>
<td>6.3</td>
</tr>
<tr>
<td>OD of Poly-urethane disc (mm) (For cushioning effect, the rubber disc shall have triangular holes along the idler axis)</td>
<td>-</td>
</tr>
</tbody>
</table>

5.2 **Idlers Spacing (Maximum)**

<table>
<thead>
<tr>
<th>Belt width (mm)</th>
<th>Carrying (mm)</th>
<th>Return (mm)</th>
<th>Impact (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1400</td>
<td>1000</td>
<td>3000</td>
<td>450</td>
</tr>
</tbody>
</table>

5.3 **Bearing for Idler Rollers**

Carrying idlers, impact idlers and return idlers will be provided with seize resistant / deep groove ball bearing of suitable size. Up to 30mm shaft dia, seize resistance bearing shall be provided and above 30mm dia deep groove ball bearing shall be provided.

The life of the bearing will be guaranteed for a minimum period of 30,000 working hours.

The bearing sizes will be as under:

<table>
<thead>
<tr>
<th>Belt width (mm)</th>
<th>Carrying/Return Idler (mm)</th>
<th>Impact Idler</th>
</tr>
</thead>
<tbody>
<tr>
<td>1400 and above</td>
<td>35</td>
<td>40</td>
</tr>
</tbody>
</table>
5.4 Idler Shaft
Idler shaft will be made of EN-8 of BS 970 or C-40 IS 1570 or equivalent quality steel and suitable size for the duty requirement.

5.5 Idler Arrangement
The carrying idler set will consist of three rollers of equal lengths. The angle of inclination of side rollers to horizontal will be 35° for all the conveyors irrespective of belt width.

Forward tilt of side rollers of carrying idlers will be provided. It will, however, not exceed 2°.

5.6 Return Idlers
The return idler will be of single roll type.

5.7 Impact Pad
At loading point impact pad shall be provided. The impact pad shall be of composite design comprising of top layer of UHMWPE (having hardness of 65+/- 5° shore A) of 10 mm thickness, middle layer of soft rubber (having hardness of 55-65° shore A) of minimum thickness 45mm and bottom layer of non-corrosive aluminium reinforcement. All three layers shall be moulded in single operation and cured for proper bonding. Fastening of clamp shall be sliding type. The length of pad shall not be less than 1300 mm. The pad shall be designed for heavy duty operation and shall be provided with heavy duty bolted frame.

5.8 Self Aligning Idlers
Self aligning troughing idlers (two sets) will be provided at 5 meters spacing from head and tail drums and the spacing of intermediate self aligning troughing, idlers will be 15 metres.

Self aligning return idlers (two sets) will be provided at 10 metres spacing from head and tail pulleys and the spacing of intermediate self aligning return idlers will be 30 meters Self-aligning idlers will also be provided near the drive and take up drums. The idlers frame will be suitably cradled about a vertical pivot, supported on bearings over a fixed plate.

5.9 Transition Idlers
Transition type idlers will be used adjacent to head and tail drums to permit proper support of loaded belt near the head and the tail drums without excessive stress and stretch of the belt edges. The transition length and the number of transition type and size of belt, number of plies and other necessary governing factors in steps of 5°, 10° and 15° troughing angles will be stated.

5.10 Clearances
Clearance, gaps, etc. for the carrying and return idlers will conform to the IS 8598-1977 to the extent possible. Lengths of individual rolls will conform to IS 1570
5.11. **Lubrication**

The idlers will be sealed and greased for life. Idler bearings will be provided with suitable labyrinth seal on outer side and felt seal on inner side. Bearing should be of 'seize resistant' type.

5.12. **Bearing Houses**

The bearing housing of idler will be made of extra deep drawn quality pressed steel and will be press fitted and will preferably be completely welded with idler tube by simultaneous welding machine. The details of this will clearly be furnished in the tender.

5.13. **Maximum Tolerance**

Eccentricity/Ovality of the idler tube will be minimum and will be mentioned specifically for various sizes and in no case it should exceed 0.8 mm at any point along the shell. Idlers will be made of ERW tubes as per IS-9295. The space for greasing will be clearly indicated on the drawing and the quantity of grease should also be indicated. It should not be less than 16 cc approx. on either side of each idler.

5.14. **Idler Brackets**

The brackets for the carrying idlers will be of pressed steel frame construction to withstand shock loads resulting from large lumps. They will be made of formed sections.

5.15. **Adjustment**

The fixing arrangement of carrying and return idlers will be such as to permit adjustment of the idler sets for purposes of belt training. Allowance for such adjustments should be provided on both sides of the conveyor and the play will not be less than 10 mm either side. All idlers will be of the 'drop-in-slot' type.

5.16. **Friction**

The friction factor of idlers will not be more than 0.02

6. **Reduction Gears**

These will be suitable for round the clock continuous operation at full load and will be suitable for moderate shock loads. The high speed shaft will be extended on other side for accommodating electromagnetic brakes, where required. The selection of gear box will preferably be done on the basics of natural cooling only.

A minimum service factor of 1.6 will be taken from motor power for selection of the gearboxes. For drive up to 30 HP worm gears will be used and above that parallel shaft bevel / helical gears are to be used. Splash lubrication will be provided. Magnetic drain plugs and metallic breathers will be provided.

7. **Couplings**

Flexible/Geared Coupling will be used for power transmission on low speed side and also on high speed side depending upon the duty requirement. The hub and
sleeves of the geared coupling will be of forged C-40 steel and bolts will be of alloy steel. The hub teeth will be triple vary crown design.

Traction type fluid couplings will be used on high speed side for all motors above 40 kW. Type and size will be selected in accordance with the drive power requirement.

8. Drums/Pulleys

8.1. Features

All the drums shall be of welded steel construction and statically balanced and stress-relieved after welding before machining. The drive, discharge and other high tension pulleys shall be of integral hub type design. The diameters of the drums shall be as per IS 8531-1977. The machining tolerance of individual parts of the drums assembly should comply with IS 919 (Current) and the diameter of the drum will be maintained within the tolerances given in IS 8531-1977. The out of roundness will not exceed ± 0.5 percent of the drum diameter. The shaft diameter will be in multiples of tens.

Face widths of the drums will be as per IS 8531-1977. Shell thickness of the drums will be suitable for taking bending loads on the drums. This will not be less than 16 mm for drive and discharge drums, 12 mm for tail pulley and other drums. No crowning will be provided with pulleys.

All drive drums will be lagged. The lagging will be vulcanised natural rubber, and the thickness of the lagging will be 12 mm. The rubber lagging will have V-type herringbone pattern grooves (6 mm wide x 6 mm deep). The apex of the grooves will be in the belt travel direction. Alternatively, herringbone profiled wear resistant rubber bars moulded with aluminium reinforcement will be preferred for easy replacement. The rubber lagging will have a minimum durometer hardness of 55 degrees shore A-scale.

8.2. Bearings and Plummer Blocks

All drums will be provided with self-aligning ball/ roller bearings to suit the loading conditions. For heavy duty conditions, where the shaft diameter exceeds 70 mm, spherical roller bearings will be provided. All bearings shall be adapter-mounted to the shafts. Plummer blocks of four holes will be of cast steel and provided with grease nipples for lubrication purpose.

All lubricating nipples will be readily accessible without removing the guards. Bearing will be protected against ingress of dust and moisture by providing suitable labyrinth/rubber seals on both sides. Guaranteed life of the bearings will not be less than 50,000 hrs. All drums of a given diameter will have similar size and type of bearings. The total stock of sizes will be kept to minimum.

8.3. Pulley Shafts

All pulley shafts shall be of C-45 steel as per IS 1570 (Current). Key less locking element/ assemblies shall be used at each end of drive, discharge and other high tension pulleys. For other pulleys, taper lock system shall be used. The locking
elements shall be sized to transmit the required torque and bending moment as per manufacturer's recommendations.

Shaft size shall be calculated with a design factor of safety of 1.5. The maximum free shaft deflection slope at the pulley hub shall be 0.0023 inch per inch.

Sizes of pulley shafts, locking devices and bearing sizes shall be rationalized to reduce inventory of spare parts and provide interchangeability.

9. **Drive Arrangement**
   The drive arrangement has been indicated in conveyor data sheet Appendix-A

10. **Bed Frame And Foundation Arrangement**
   The drive unit consisting of motor, reduction gear and the drive drums will have a common bed frame and be fabricated from heavy structural sections and plates. Suitable bracings should be provided wherever necessary on the drive unit bed frame and superstructure to make it rigid. Proper arrangements will be provided with gearboxes, motors and plummer blocks to maintain correct alignment.

   The head drum unit, the drive unit, the take up unit and the tail unit will have separate houses with suitable foundation arrangement in conformity with the drawings (if any). Suitable bracings will be provided on the structures of these units wherever necessary. Dual drives will be grouted on suitable firm ground.

11. **Decking Plate**
   Framed steel sheet decking plates to protect the bottom belt against spillage should be provided throughout the length of the conveyor. The thickness of decking plate shall not be less than 3.15 mm.

   A "V" type plough scraper (60° angle) will be provided on the return belt near the tail drum. In conveyors using loop/vertical gravity take up, 'V' type plough scraper will also be provided near the snub drum forming part of take up unit to prevent material spilled on the return belt, from damaging the belt at the take up drums.

12. **Skirt Board & Sealing System**
   Skirt board shall ensure centralised loading of conveyor belt to avoid coal spillage. Suitable 'Skirt Plates' of 5.0 meters length shall be provided at each feeding point of conveyor. The width of the Skirt Boards shall be two-third the conveyor belt width. The gap between the bottom of the skirt board and the belt shall be made to increase uniformly in the direction of belt travel.

   The height of skirt board shall be sufficient to contain the material volume as it is loaded on the belt and shall not be less than 500mm. In addition a covered hood of 500mm height shall be provided to contain dust pressure. The segmented rubber curtains shall be hung from the top of the hood at regular intervals in segmented manner. End of the skirt board shall be provided with rubber curtain. At the tail end,
a sealing box shall be provided which shall be 750mm long and 500mm high. At the tail end/ rear side also, skirt sealing shall be provided.

To prevent material spillage at conveyor transfer points, skirt board sealing systems consisting of rubber which tail into each other to provide a continuous sealing strip, will be provided. The fixing of skirt board rubber block shall be press-fit type between adjacent rubber to avoid leakage of dust. Equally spaced guides shall be provided for smooth vertical movements. The clamp shall be of serrated type to ensure uni-directional motion of the rubber block towards the belt. The shore hardness of rubber block shall be 55± 5° shore A. The clamps and fixing bolts shall be galvanized for longer life.

13. Belt Cleaners

Primary and secondary belt cleaners will be provided suitable for mounting on the Head Pulley conveyor to remove heavy residual layer of carry back from the conveyor belt. Primary belt cleaner shall be provided with polyurethane blade (having hardness of 90± 5° shore A) mounted on a carrier assembly with 'elastomount' or similar system to facilitate automatic blade adjustment. The blades of secondary belt cleaner shall be made of special tungsten carbide tip with SS-304 base.

Belt cleaners will have multi-sprung blades with suitable inclination to clean dirt layer efficiently and suitable sprung deflection on contact with an uneven surface on the belt. Each individual blade should have spring action so that constant contact with the belt is maintained while in operation. For automatic adjustment and to compensate for blade wear, the belt cleaner assembly should be mounted on ‘elastomount’ or similar suitable arrangement to ensure that constant contact between belt and blades is maintained.

The unit should be supplied with a locking system to prevent cleaning component from touching the belt and damaging the same. The complete system will be such that it can be installed on the conveyor's sub frame by means of modular support mounts.

14. Hold Back Device

Suitable hold back devices will be provided with Gear box for preventing running back of the conveyor belt in loaded conditions due to power failure or otherwise. This will be roller type and will be supplied wherever the conditions require the use of this device.

11. Electro Magnetic Brakes

Electro magnetic brakes will be provided with all the conveyors after calculating the coasting time. If required, necessary flywheels can also be used for smaller conveyors. The coasting time calculation will be submitted for approval. The conveyor 9C is having down hill and up hill profile along th length of conveyor, suitable and sufficient capacity break shall be provided as per design requirement
16. **Accessories**

16.1. **Pull Chord Switches**

For stopping the conveyor from any point along the conveyor length, pull chord switches will be provided on one side of the whole conveyor length. This will be a totally enclosed dust and vermin proof, cast metal unit with trip and reset levers mounted along the main walkway side at regular spacing of 50 metres (with min. one per conveyor). The pull chord rope will be of PVC sheathed galvanized steel wires. The switch should have inbuilt visual indication.

16.2. **Belt Sway Switch**

Totally enclosed dust and vermin proof belt sway switches will be provided on both sides along the conveyor length at a regular interval of 50 metres. Belt sway switches will also be provided near head drums, tail drums and drive drums. These switches will be auto reset double contact type, one for advance indication of excessive belt sway and the other for hipping in conveyor. The switch should have inbuilt visual indication.

16.3. **Zero Speed Switch/Belt Sequence Switch**

One number belt speed monitoring switch per conveyor will be provided which will stop the conveyor in case of slippage or breakage of the belt, or in case the belt speed falls below 80% of the rated speed. These switches will also serve as belt sequence switches for the starting of the preceding conveyor. The switch should have inbuilt visual indication.

17. **Guards** (See also specification No. SP/M-16)

Guards on the conveyor will comply with the relevant latest Indian Standards. The guards will be of expanded metal conforming to IS 412 (Current). The minimum clearance between the guards and moving parts at openings in guards will be as follows:

<table>
<thead>
<tr>
<th>Size of opening in guard (mm)</th>
<th>Minimum clearance (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not exceeding 10</td>
<td>25</td>
</tr>
<tr>
<td>Over 10 up to and including 15</td>
<td>65</td>
</tr>
<tr>
<td>Over 15 up to and including 30</td>
<td>100</td>
</tr>
<tr>
<td>Over 30 up to and including 40</td>
<td>125</td>
</tr>
</tbody>
</table>

Slots 30 mm wide suitably reinforced may be provided in guards for insertion of bars for cleaning. The minimum distance between any moving part of the conveyor and any part of the slot will be 300 mm.

Guards will totally enclose all parts as far as practicable in order to prevent access to the part e.g. for an in running belt, the guard around which an operator can put
his arm will extend at least 900 mm from the belt. All surface and overhead conveyors will have a walkway of 1.2 m on both sides.

In case of the travelling tripper conveyor, the following sub clauses will also apply.

**Access**

Where there is any danger of trapping a person between the moving tripper conveyor and any fixed object, other than its track, there will be minimum clearance of 500 mm.

**Guards**

Guards will be provided to prevent any trapping between the travelling wheels and the rails.

18. **Inspection and Quality Control Before Despatch**

18.1. **Special Materials**

In addition to the prescribed inspection and quality control measures adopted by the conveyor manufacturers/Contractors during raw materials purchase, sub assembly and final assembly stages the manufacturers/Contractor should be prepared to furnish without extra charge test certificates covering mechanical properties and chemical composition for the materials used (e.g. materials for idler or drum shafts). This certificate should be from approved testing laboratories such as Small Industries Services, Institute Laboratories, CMERI- Dhanbad or NPL- New Delhi, etc. Samples of such materials are to be selected as per relevant latest Indian Standards and Codes by purchaser's representative from manufactured components of the equipment.

18.2. **Test Rig For Idlers After assembly before despatch**

The idlers based on approved drawing should be tested after assembly for non load run on a suitable test rig capable of running idlers to a suitable speed higher than rated speed for given time This test rig speed will not exceed 3 to 4 times the rated speed.

18.3. **Bearings**

A certain percentage of anti friction bearing to be selected at random will be checked for boundary dimensions keeping in view the permissible tolerances as per AFBMA, USA standards or equivalent. The test certificate will also suitably certify bearings to be free from abnormal noise.

18.2 **No Load Test Run Of Conveyor Drive Head**

The conveyor drive head comprising of motor, reduction, gear, coupling, driving drum, etc. mounted on a composite rigid base frame will be subjected to a no load test run for few hours to check for abnormally high temperatures or abnormal conditions including too much noise. The conveyor manufacture will furnish a test
18.5. Additional Tests

The following additional tests also may be carried out, at the option of the employer, and all facilities for carrying out such tests will be extended by the Contractor at his own cost.

a) Dimensional checking of all items.

b) Materials test certificates for material of construction.

c) For idlers the following tests will be carried out:
   
   i) Friction factor test.
   
   ii) Idler running test at high speed.
   
   iii) Test for dust proof and water proof.
   
   iv) Ovality test of finish idler.
   
   v) Alignment and co-axiality test of idler set assembly.

d) For pulleys following tests will be carried out:
   
   i) Checking of out of roundness.
   
   ii) Static balancing test.

e) Test of bought out items.

All tests will be carried out in terms of relevant IS codes and standard engineering practices.
BELTING

1. Basic parameters

1.1 Carrying material

i) Coal /shale of Maximum size 200 mm.

ii) Percentage of shale/sand stone up to 30%.

iii) Percentage of moisture up to 20%

iv) Bulk density : 0.8 -1.15 t/m³.

v) Condition of material-wet & sticky.

2. Duty Conditions

Belting will be designed for heavy-duty condition and will be suitable for 24 effective working hour operations per working day and 365 working days per year. It will be suitable for installation over conveyor systems having 35° troughing angle, and will be suitable for operation at an ambient temperature from 4° to 50°C. It will have sufficient resistance against exposure to open sunlight so that its qualities do not deteriorate while working in open sun. It also may have to work in rain and/or in conditions where relative humidity goes up to 100%.

3. Specification for N/N Belting

3.1 Constructional Features:

The belting shall consist of a carcass having rubber covers. The carcass will consist of number of plies. The specified construction of ply type belting will be full width ply only.

The fabric shall be of Nylon having grade Nylon-66, with minimum melting point 250°C.

The belting shall be with pre-stretched, straight ply, skim coated with open ends. It will have sufficient strength as specified else where, to give required tension at safety factor of 10 and utilisation factor as 80% (maximum).

The belt shall have sufficient lateral flexibility so that it suits the troughing angle requirements even when it is empty. It will have sufficient lateral stiffness. The belt will have sufficient longitudinal flexibility so that it can easily flex around different pulleys of the conveyor system.

The belt shall have sufficient impact resistance to withstand impact at the loading points. The rubber cover used in the top and bottom cover of the belting will be of Fire Resistant Anti Static (FRAS) grade. Rubber cover when removed from the belt and tested as described in relevant IS./ISO-340 the minimum tensile strength shall be 17 Mpa and minimum elongation at break will not be less than the 350% as specified in the IS. After ageing as per provision of IS the variation in the original values of tensile strength and elongation should not exceed the value as specified
in the IS. The edges will be of cut edge construction. On the carrying surface, at interval of maximum 12 m, the belting will be marked as follows:-(a) Manufactures name and trade mark, if any
(b) Fabric designation as N/N.
(c) Belt designation i.e kN/m.
(d) Grade of rubber cover shall be fire resistant and anti static. i.e FRAS Grade as per IS-1891(part-5);1993.
(e) Last two digits of the year of manufacturing, say -99 for 1999 and 00 for 2000.
(f) BIS Code reference i.e 1891 (pt-1)-1994

3.2 Packing
Belt will be packed in a wooden drums. This packing will enable the easy unreeling of the belting. On the body of the wooden drum the direction of belt and the location of end of the belting should be indicated so that belting can be properly placed while unreeling.

3.3 Compliance with standards:
The design, construction, testing and performance of the belting will comply with all applicable codes and as per IS 1891/1994 or equivalent. International standards.

3.4 Inspection and quality control:
3.4.1 Before despatch, the finished material will be subject to inspection by the authorities/representatives of the owner. The inspection will be carried out in the presence of the contractor, in terms of up-to date engineering practice and relevant Indian standards/International standards in this respect, for which all facilities will be provided by the contractor at his cost. This will inter-alia, include the following:-

a) Full thickness belt test:
   i) Breaking load, Kg/Sq.Cm. for warp and weft.
   ii) Elongation under reference load (%).
   iii) Elongation at break (%).

b) Rubber Cover test (Top/Bottom):
   i) Tensile strength of cover (Kg/Sq.Cm)
   ii) Elongation at break (%).
   iii) Adhesion between ply to ply and between covers and ply.
   iv) Abrasion loss of rubber cover.
   v) Drum friction test
vi) Flame test  
vii) Electrical surface resistance test (Anti static test)

c) Physical dimension check  
d) Troughability test  

3.4.2 All relevant type test certificates will have to be produced during inspection and along with supply for necessary verification and approval.
1.0 GENERAL REQUIREMENT

The industrial duty freight cum passenger lift will serve the various levels at ground, different working floor levels of the receiving pit complex & at SILO and any other levels as may be felt necessarily during detail engineering stage for efficient plant maintenance and operation. The lift will have the following operating parameters as per IS.

The lift shall have following operating parameters:

i) Capacity - 1000 kg freight or 10 persons
ii) Speed - As per requirement
iii) Lift size - To suit 10 persons with minimum space of 0.2 m² per person and 2200 mm height clear opening
iv) No. of steps - As required
v) Quantity - 2 (1 at silo, 1 at receiving pit)

The lift shall be of sheet steel (16 SWG MS Sheet) construction with 5 mm thick heavy duty chequered floor and steel collapsible doors and shall be complete with UP/DOWN ARROWS at all landings and with semi-dual (with/without attendant) operation position indicator and battery operated alarm belt, necessary switches, brakes, push button, limit switches, safety gears etc. The design, supply and installation shall conform to the relevant Indian Standards and Codes of Practices. The machine room shall be located at the top of the lift shaft and the lift shall travel from ground to Silo top with steps at intermediate floors as required. and designed, constructed and installed in accordance with the latest version of the following standards:

IS: 4666 : Specification for electric passengers and goods lift
IS: 3534 : Outline dimensions for electrical lifts
IS: 732 : Code of practice for electrical wiring installations
IS: 2365 : Steel wire suspension ropes for Lifts, Elevators & Hoists

Indian Electricity Act 2003, Indian Electricity Rules 1956

For lift, installation, operation and maintenance should be carried out in conformity with lift acts and rules in force.

Conformity with Fire/Indian standard Specifications/Regulations
The installations shall be carried out in conformity with local fire regulations and rules in force. All materials, fittings, appliances etc. used in electrical installations shall conform to Indian Standard Specifications.

2.0 Inspection and Quality Control

2.1 Special material

The manufacturer should furnish during inspection, without extra charge, test certificates covering mechanical properties and chemical composition for special raw materials used including that of liners. The certificates should be from the approved testing laboratories like CMERI-Dhanbad, NPL-New Delhi etc. If considered necessary, samples for such material and components may be selected as per IS: 1548 (current) by the employer's representative from amongst the raw materials and manufactured components of equipment and tested in the approved laboratory. In case samples so selected fail to meet the standard specifications, the whole lot of the manufactured components will be rejected and disqualified for use again for any CIL supplies.

2.2 Stage Inspection

The Employer reserves the right to carry out inspections at any stage of the process of manufacture and assembly for which all facilities will be provided by the manufacturer. Before carrying out such inspections, necessary advance information will be given to the manufacturer.

2.3 Availability of standard specification Meters, Gauges, etc. for testing and inspection

The manufacturer will maintain all relevant standards and codes of practices for manufacture, inspection and testing of components of the equipment ordered. He will also maintain a set of meters and gauges etc. as may be required for testing and inspection of components.

3.0 Inspection Checks during:

The details of the checks to be carried for various components are to be submitted by the contractor for Owner’s approval. However some indicative checks on different items are given below which should necessarily form part of the quality assurance programme to be agreed with the Owner.

3.1 All plates above 20 mm thickness shall be ultrasonically tested for laminations. Shaft forgings and castings shall be checked for hardness microstructure & ultrasonic testing in addition to check for chemical and mechanical properties.

3.2 Following minimum NDT requirements to be ensured for welds:

i) Butt welds : 10 % Ultrasonic / Radiographic & 100% MPI
ii) Fillet welds : 10% Magnetic particle
## TECHNICAL PARTICULARS OF PASSENGER LIFTS

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Particulars</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Passenger, or goods</td>
<td>Passenger</td>
</tr>
<tr>
<td>2</td>
<td>Number of lifts required</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Load -Kgs.</td>
<td>1000 kg</td>
</tr>
<tr>
<td>4</td>
<td>Speed – m/sec</td>
<td>As per requirement</td>
</tr>
<tr>
<td>5</td>
<td>Travel – mtrs</td>
<td>one number from MCC room to top of the Silo and another in receiving pit.</td>
</tr>
<tr>
<td>6</td>
<td>Stops &amp; Openings</td>
<td>As per requirement of design (All openings on the same side)</td>
</tr>
<tr>
<td>7</td>
<td>Power Supply</td>
<td>440 Volts 3 phase, 50 Hz. Alternating Current</td>
</tr>
<tr>
<td>8</td>
<td>Control</td>
<td>Electro-Mechanical type.</td>
</tr>
<tr>
<td>9</td>
<td>Operation</td>
<td>Simplex. Full collective (with/without Attendant)</td>
</tr>
<tr>
<td>10</td>
<td>Machine</td>
<td>Geared traction machine placed directly above hoist way in machine room</td>
</tr>
<tr>
<td>11</td>
<td>Car Size (W X D) – mm</td>
<td>1600 x 1800</td>
</tr>
<tr>
<td>12</td>
<td>Hoist way required</td>
<td>1600 x 1800 x 2200 (W X D X H) – mm</td>
</tr>
<tr>
<td>13</td>
<td>Car Panels</td>
<td>All plain powder painted panels</td>
</tr>
<tr>
<td>14</td>
<td>Handrails on 3 sides</td>
<td>M. S. Powder Painted - Black Matt</td>
</tr>
<tr>
<td>15</td>
<td>False Ceiling</td>
<td>To be provided</td>
</tr>
<tr>
<td>16</td>
<td>Flooring</td>
<td>Vinyl tiles</td>
</tr>
<tr>
<td>17</td>
<td>Car Entrance</td>
<td>Protected by centre opening sliding steel door in plain powder painted finish</td>
</tr>
<tr>
<td>18</td>
<td>Size (W X H) – mm</td>
<td>800 x 2200</td>
</tr>
<tr>
<td>19</td>
<td>Hoistway Entrances</td>
<td>Protected by centre opening sliding steel doors in plain powder painted finish</td>
</tr>
<tr>
<td>20</td>
<td>Size (W X H) – mm</td>
<td>800 x 2200</td>
</tr>
<tr>
<td>21</td>
<td>Door operation</td>
<td>Automatic</td>
</tr>
</tbody>
</table>
| 22      | Signal details                                   | 1) Combined luminous hall button and digital hall position indicator  
2) Integral full height car operating panel with luminous buttons digital car position indicator combined with direction arrows overload warning indicator and service cabinet  
3) Battery Operated Alarm Bell & Emergency Light  
4) Fireman’s switch at main lobby  
5) Automatic Rescue Device |
5.0 CAR

The car shall be enclosed on all sides by means of car body with centre opening sliding type door sliding horizontally and consisting of two panels with vision panel opening from the centre and so inter connected that they move simultaneously with provision of power operated device for opening and closing of doors. The enclosure shall be of sufficient strength to withstand thrust forces. The sides of car shall be lined with heavy gauge sheet panels properly braced and reinforced. The enclosure shall be flushed on the inside and securely fastened to the platform. The roof shall be covered with sheet metal. The construction of roof should be strong enough to be capable of supporting at least two persons. The car shall be equipped with fan with grills and suitable lighting complete with fittings and shall be provided with separate switches for fan and light.

Provision shall be made for car door electrical contact, electrical and mechanical interlock, electro mechanical lock, emergency stop push button, floor selector and floor stopping switch.

6.0 HOIST WAY DOORS

The hoist way doors shall be horizontally centre opening steel sliding door with wide vision panel at each landing of dimension matching with car door

7.0 DOOR HANGERS AND TRACK

Hangers and tracks for car door and each hoist way door shall be furnished. Suitable material shall be used to minimize noise. Rollers or equal arrangement shall be provided to take upward thrust of the doors. All required materials for landing entrance shall be provided.

8.0 OPERATIONS FOR CAR DOORS AND HOIST DOOR

The car door and the hoist way door shall open automatically when the car stops at landing. In case of power failure, the door operations shall be so designed that it can be opened manually from inside the car. The hoist way door shall not open automatically before the car reaches at landing level.

9.0 CONTROL, OPERATION & INTERLOCK

The control system governing, starting, stopping, direction of motion, acceleration, speed and retardation and accessories required for satisfactory and trouble free operation, protection and control of the lift shall be provided.

The lift shall be suitable for automatic operation by a momentary pressure of a button such that the lift car is set in motion and caused to stop automatically at any required landing.

The lift operation shall conform to the following requirements:

a) The operation of the lift shall be through a push button station located inside the car
b) The lift shall not move unless the car door, landing door and all other protected openings connected with control circuit are closed
c) The push buttons, one for upward movement and the other for downward movement, at each terminal landing shall be provided in order to call the car
d) The landing doors shall be inter-locked so that the landing door of any floor shall
not open when the lift is not on that floor

e) Push button shall be fixed in the car for holding the doors open for any length of time

Provision shall be made for safety gear, terminal slow down switch, terminal stopping switch-normal, terminal stopping device-final

10.0 CAR OPERATING PANEL

In the car, there shall be an operating panel containing push buttons, elevations of the landings served; two-position key-operated switch, marked to indicate “with attendant” and “without attendant”; an emergency stop switch; a buzzer; an emergency call button connected to a bell to serve as an emergency signal; push button or switches for lighting and fan; other push buttons; switches, etc. as required.

11.0 INDICATOR

The lift shall be provided with position indicator and call indicators inside the lift car to show the position of the lift car with reference to the floor numbers and the landing from which the call is being received. Up and down travel direction and position indicating signals shall be provided on each landing for the lift. Various indicators shall be of standard construction.

12.0 TERMINAL BUFFERS

The terminal buffers shall be provided for stopping the car and the counter-weight at the extreme ends of travel. Buffer support channels required to install the buffers shall be supplied.

13.0 LOAD PLATE

A load plate giving rated payload of the lift shall be fitted in the car in a conspicuous position. The rated load shall be given in kilograms and also in number of persons.

14.0 COUNTER WEIGHT AND COUNTER WEIGHT FRAMES

Counter-weight sections shall be mounted on structural metal frames so designed to retain the weight securely in its place.

Counter-weight frames shall be guided on each rail guide by upper and lower guiding members attached to the frame. A substantial metal counter-weight guard of required length shall be provided at the bottom of the hoist way.

15.0 GUIDES FOR CAR & COUNTER WEIGHT

Car and counter-weight guides shall be of rigid steel and shall be continuous throughout the entire lengths and shall be provided with adequate steel bracings and stiffeners. Guides for both car and counter-weight shall meet with the requirements of IS:4666. Necessary lubrication device for guide rail shall be provided.

Normal Terminal Limit Switch shall be provided to slowdown and stop the car automatically at terminal landings and final limit switches shall be provided to automatically cut-off the power and apply the brake, to stop the car travel beyond the terminal landings.
16.0 DRIVE MOTORS
The design ambient temperature for the equipment shall be taken as 50 deg. C. The insulation shall be Class 'E'. Necessary brakes shall be provided in the traction machine. Protective devices shall be provided on the controller to protect against phase reversal, low voltage and phase failure. Overload and other protective relays shall also be provided.

The lift shall be driven by a squirrel cage TEFC induction motor to IP 55 protection and suitable for 120 Starts/hr. Motor and all electricals should have a dust proof sealing arrangement.

The kW rating of main drive motor shall be selected keeping a minimum margin of 15% over maximum power requirement.

17.0 OTHER ACCESSORIES
All other accessories like switches, fuses, contactors, cables, etc shall be provided as per requirement.

18. Inspection and Quality Control Before Despatch

18.1 Special Materials
In addition to the prescribed inspection and quality control measures adopted by the conveyor manufacturers/Contractors during raw materials purchase, sub assembly and final assembly stages the manufacturers/Contractor should be prepared to furnish without extra charge test certificates covering mechanical properties and chemical composition for the materials used (e.g. materials for idler or drum shafts). This certificate should be from approved testing laboratories such as Small Industries Services, Institute Laboratories, CMERI-Dhanbad or NPL-New Delhi, etc. Samples of such materials are to be selected as per relevant latest Indian Standards and Codes by purchaser's representative from manufactured components of the equipment.

12.3 Availability of standard specification Meters, Gauges, etc. for testing and inspection
The manufacturer will maintain all relevant standards and codes of practices for manufacture, inspection and testing of components of the equipment ordered. He will also maintain a set of meters and gauges etc. as may be required for testing and inspection of components.

12.4 Checks during inspection:
The details of the checks to be carried for various components are to be submitted by the contractor for Consultant/Owner’s approval. However, some indicative checks on different items are given below which should necessarily form part of the quality assurance programme to be agreed with the Consultant/Owner.

12.6 All plates above 20mm thickness to be ultrasonically tested for laminations. Shaft forgings and castings to be checked for hardness, microstructure and ultrasonic testing in addition to check for chemical and mechanical properties

12.6 Following minimum NDT requirements to be ensured for welds:

   I) Butt welds : 10% Ultrasonic / Radiographic & 100% MPI ii) Fillet welds : 10% Magnetic particle
1.0 **BASIC PARAMETERS**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width of conveyor belt</td>
<td>1400 mm</td>
</tr>
<tr>
<td>Conveyor carrying capacity</td>
<td>1200 TPH</td>
</tr>
<tr>
<td>Belt speed</td>
<td>3.0/2.85 m/sec</td>
</tr>
<tr>
<td>Maximum size of coal over the conveyor</td>
<td>300 mm</td>
</tr>
<tr>
<td>Operating height</td>
<td>500 mm</td>
</tr>
<tr>
<td>Lifting capacity</td>
<td>50 kg of iron/ferrous material</td>
</tr>
</tbody>
</table>

2.0 **DUTY CONDITION**

The equipment shall be installed across the 1600mm wide conveyor 3C&4C. The equipment shall have sufficient capacity to lift pieces of (a) Iron / Ferrous material of weight up to 50kg with L/D not exceeding 5 (b) MS cube of 20mm size (c) MS plate of 250x250x10 mm size (d) shovel teeth and spikes of carbon steel and (e) MS nuts and bolts, even while the same may be hidden under the coal bed on the conveyor. This shall be located before the tramp metal detector. Inline magnetic separator (suspended type) shall be provided for continuous and automatic extraction and discharge of tramp magnetic pieces from coal being discharged from conveyor as specified. The sets shall be complete in all respects with drives, magnets, hoppers, chutes, tramp-iron boxes and all electrical ancillaries like control panels etc.

3.0 **CONSTRUCTIONAL FEATURES**

3.1 In general the equipment shall have all necessary technical features for its efficient and successful operation. It shall be complete with all accessories and facilities including, magnet coil, rectifier set, control panel along with supporting chain and power supply system. The equipment shall be self-cleaning type. A suitable arrangement shall be made to discharge the trapped iron pieces.

3.2 Magnetic core material shall be pure annealed iron or equivalent high permeability magnetic material. The coil shall be of aluminium wire class-H insulation, to limit the absolute temperature of the winding to 140°C
3.3 A minimum force index of 100,000 (product of flux density in gauss and rate of change of gauss) and a flux density of 1000 gauss shall be available at the lowest location (in hot running condition) in coal thickness all through the width of coal bed from where steel pieces are to be picked. Gauss visa distance curves of the magnet shall be submitted for CMPDI approval.

3.4 The cross section of magnet shall be suitably designed to provide sufficient area for magnetising the coil effectively covering full cross section of the discharged material. The in-line magnetic separator shall be located such that it picks up tramp iron from coal trajectory after it has been discharge from the head pulley.

3.5 The tramp magnetic piece picked up by the magnetic separator shall be discharged suitably to ensure that it falls into the tramp iron chute, which shall be provided up to ground level for discharge into a tyre-mounted trolley to facilitate disposal at designated place.

3.6 Bidder shall furnish justification supporting the selection of magnetic separator.

3.7 The chute work in the magnetic zone of the magnet shall be of nonmagnetic stainless steel.

3.8 The magnetic separator units shall be supported by suitable structural member from the top by taking support from the steel beams with turn buckle arrangement to facilitate the necessary adjustments during operation.

3.9 ON/OFF control push button with indicating lamps shall be provided at the local station.

3.10 Suitable arrangement shall be provided in the magnet for keeping the coil of the magnet dry from atmospheric condensation when the magnetic separator is not in use.

4 Inspection and Quality Control

4.1 Special material
The manufacturer should furnish during inspection, without extra charge, test certificates covering mechanical properties and chemical composition for special raw materials used including that of liners. The certificates should be from the approved testing laboratories like CMERI-Dhanbad, NPL-New Delhi etc. If considered necessary, samples for such material and components may be selected as per IS : 1548 (current) by the employer's representative from amongst the raw materials and manufactured components of equipment and tested in the approved laboratory. In case samples so selected fail to meet the standard specifications, the whole lot of the manufactured components will be rejected and disqualified for use again for any CIL supplies.

4.2 Stage Inspection
The Employer reserves the right to carry out inspections at any stage of the process of manufacture and assembly for which all facilities will be provided by the manufacturer. Before carrying out such inspections, necessary advance information will be given to the manufacturer.
4.3 Availability of standard specification Meters, Gauges, etc. for testing and inspection
The manufacturer will maintain all relevant standards and codes of practices for manufacture, inspection and testing of components of the equipment ordered. He will also maintain a set of meters and gauges etc. as may be required for testing and inspection of components.

5.0 INSPECTION CHECKS
The details of the checks to be carried for various components are to be submitted by the contractor for Owner’s approval. However some indicative checks on different items are given below which should necessarily form part of the quality assurance programme to be agreed with the Owner.

All plates above 20 mm thickness to be ultrasonically tested for laminations. Shaft forgings and castings to be checked for hardness, microstructure and ultrasonic testing in addition to check for chemicals and mechanicals properties
Following minimum NDT requirements to be ensured for welds:

i) Butt welds : 10 % UT / RT and 100 % MPI
ii) Fillet welds : 10% MPI

6.0 COMPLIANCE WITH STANDARD
The equipment design and construction shall comply with relevant I.S or in its absence with equivalent international standard and up to date engineering practice.
1.0 GENERAL

The function of this unit will be to pick magnetic substance and detect non magnetic substances like manganese steel, brass, aluminium or any other metal that may come along with ROM coal. Metal Detector of coil type shall be provided at the conveyor 3C&4C near the pent house on horizontal portion to detect metallic objects in the coal stream. It should be capable of detecting the metal without obstructing the coal flow while the belt is running at its full capacity.

2.0 COMPLIANCE WITH STANDARD

The equipment design and construction shall comply with relevant I.S or in its absence with equivalent international standard and up to date engineering practice.

3.0 DUTY REQUIREMENT

Metal detectors shall have high reliability with enough sensitivity to detect 25mm aluminium sphere below the burden of coal shall also detect other metals like brass, copper, stainless steel, manganese steel, bars, scraps etc. 3.1

Conveyor 3C&4C:

3.1.1 Width - 1400 mm
3.1.2 Capacity - 1200 TPH
3.1.3 Speed - 3.0/2.85 m/sec

4.0 CONSTRUCTIONAL REQUIREMENT

4.1 Fibre glass enclosures shall be provided for all type of coils
4.2 Suitable tramp metal marker shall be provided
4.3 Local control panel shall be provided with IP-62 degree of protection

5.0 INSPECTION AND QUALITY CONTROL

5.1 Special material

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6.0 CHECKS DURING INSPECTION
The details of the checks to be carried for various components are to be submitted by the contractor for Owner’s approval. However, some indicative checks on different items are given below which should necessarily form part of the quality assurance programme to be agreed with the Owner.

6.1 All plates above 20 mm thickness to be ultrasonically tested for laminations. Shaft forgings and castings to be checked for hardness, microstructure and ultrasonic testing in addition to check for chemical and mechanical properties.

6.2 Following minimum NDT requirements to be ensured for welds:

   i) Butt welds : 10 % Ultrasonic / Radiographic and 100 % Magnetic particle

   ii) Fillet welds : 10% Magnetic particle
1.0 INTRODUCTION
Coal handling plant broadly consists of receiving pit with crushing system, storage & reclamation, silo with rapid loading system.

2.0 FIRE PROTECTION

Various fire fighting system shall be provided to protect the Coal Handling plant from fire hazards. The design and installation of the system shall comply with the regulations of the Tariff Advisory Committee (TAC) of India/ National Fire Protection Association (NFPA), USA, Codes.

The various fire fighting systems, facilities and the areas protected there by shall be as under :

**Fire Fighting System :**

i) High pressure hydrant system : Throughout the coal handling plant

ii) Mobile/portable fire extinguishers Throughout the Coal handling plant

2.0 SYSTEM DESCRIPTION

2.1 High Pressure Hydrant System
Water from the reservoir shall be pumped by adequate number of electric motor driven centrifugal pumps for the hydrant system and water spray system. One diesel engine driven pump each shall be provided as a standby for the hydrant and water spray systems. The fire pumps shall be of the same capacity and suitable for parallel operation.

i) The hydrant system shall consist of a large network of pipes both underground and over-ground which feed pressurised water obtained from fire water pumps to a number of indoor and outdoor hydrant valves. The entire piping network has been devided into two circuits one from receiving pit to ground bunker and another from ground bunker to silo. Water for the respective circuits shall be drawn from the reservoirs located near receiving pit and bunker respectively.

ii) The hydrant main remains pressurised at a pressure not less than 7 kg/cm2. In the event of a fire, the hydrants close to the seat of fire open, causing a drop in water pressure in the hydrant main which brings the hydrant pump into operation automatically, ensuring steady supply of water to the system. If the main pump fails to start initially, the standby pump comes into operation automatically. However, the pumps can only be stopped manually after ascertaining that the fire is extinguished.

iii) Total hydrants required shall be estimated as per TAC recommendations. Proposed locations of hydrants shall be shown in table and drawing.
2.3 **Portable/Mobile Fire Extinguishers**

Various types of portable and mobile fire extinguishers shall be provided at strategic locations in the Coal Handling Plant for fire protection.

3.0 **SPECIAL REQUIREMENTS**

3.1 **High Pressure hydrant System**

i) The total water requirement of the hydrant system shall be met by suitable capacity pumps in accordance with the stipulations of the Fire Protection Manual of TAC considering the coal handling plant as an ordinary hazard occupancy. The pump head shall be so selected that a minimum running pressure of 3.5 kg/cm$^2$ at a discharge head equivalent to half the aggregate pumping capacity is available at the hydraulically remotest hydrant point and a running pressure of 3.5 kg/cm$^2$ shall be available at a remote hydrant point.

ii) Water for the hydrant system shall be handled by two pumps, one driven by an electric motor and the other driven by diesel engine. The pumps shall be horizontal centrifugal type, drawing water from the fire water sump.

iii) Pumps both in the high pressure hydrant and water spray systems shall be suitable for parallel operation.

iv) The hydrant pump and sprinkler pump headers shall be connected through a stop valve and a non-return valve so that the hydrant pumps can supply water to the sprinkler circuit. However, the reverse shall not be possible.

v) The number of hydrants shall be in accordance with TAC/NFPA regulations. A set of two lengths of 15 m hoses, a nozzle and a branch pipe shall be kept in hose boxes adjacent to each hydrant.

vi) Hose houses shall be located at strategic places, each covering a group of external hydrants. Each hose house shall have sufficient number of 15 m hoses, a branch pipe and nozzles in accordance with TAC/NFPA regulations.

vii) Fog nozzles shall be used for spraying atomised hydrant water on electrical fires in a discontinuous fog jet to avoid electrical shocks.

viii) Air release valves shall be provided at the highest points of crusher areas, substations and the Silo complex.

3.2 The hydrant system shall be kept pressurised by jockey pump of suitable capacity to make up small system leakage and maintain pressure in hydrant and sprinkler system.

Jockey pump shall cut in approximately at 0.35 kg/cm$^2$ drop and cut out at normal system pressure. Fire pumps shall be arranged to cut in approximately at 1 kg/cm$^2$ drop and cut out manually at churn pressure.
4.0 INSPECTION AND QUALITY CONTROL

4.1. Special material

The manufacturer should furnish during inspection, without extra charge, test certificates covering mechanical properties and chemical composition for special raw materials used including that of liners. The certificates should be from the approved testing laboratories like CMERI-Dhanbad, NPL-New Delhi etc. If considered necessary, samples for such material and components may be selected as per IS: 1548 (current) by the employer's representative from amongst the raw materials and manufactured components of equipment and tested in the approved laboratory. In case samples so selected fail to meet the standard specifications, the whole lot of the manufactured components will be rejected and disqualified for use again for any CIL supplies.

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i) Butt welds : 10 % Ultrasonic / Radiographic and 100 % Magnetic particle
   ii) Fillet welds : 10% Magnetic particle
BELT VULCANISER

1.0 Scope:

This specification covers the design, manufacture, constructional features, performance requirements for supply, installations, painting, testing and commissioning of belt vulcanisers to be used in maintenance of coal handling plant.

2.0 Applicable standards & codes:

The equipment shall be designed and manufactured in accordance with the latest revision of BIS. Wherever BIS are not available, British standard /American standard/DIN/JIS or any other equivalent superior standard shall be followed. Any amendment/revision in above standard that may be in force during the period of manufacture shall also be taken into consideration.

Besides the above, the equipment covered under this specification shall comply with the requirements of all latest applicable statutory acts, regulations which may be in force during the period of execution and which are related with design, construction and operation of the equipment in the location where it will be installed.

3.0 DUTY

The vulcaniser shall be light portable and suitable for belt vulcanising, longitudinal rip repair and spot repair.

4.0 DESIGN&CONSTRUCTIONAL FEATURES

4.1 The Machine shall be light and portable.

4.2 The heating platens and crossbeam shall be of high strength extruded aluminium alloy plates & sections.

4.3.1 Size of platens shall be adequate to cover the entire spliced area of belt so as to vulcanise the belt in single setting.

4.3.2 The design layout and ratings of the heating elements in the platens should ensure uniform temperature distribution. Vulcanising temperature of 145 degree centigrade should be reached at the belt with in 30 minutes.

4.3.3 Design shall ensure accurate control of temperature(145 °C +/- 5 °C) even with voltage fluctuation.
4.3.4 Hydraulic pressure system consisting of hydraulic hand pump, distributor hoses and hydraulic cross beams shall be provided.

4.3.5 High pressure hoses to be provided with quick release couplings for quick and easy Cross beams to be provided with closure nipples so that during vulcanising even if there is a sudden pressure drop due to hose burst or inadvertent quick release of release and vulcanising can continue.

4.3.6 Adequate number of hydraulic cross beams to be provided for uniform pressure over the entire spliced area of belt.

4.3.7 Cross beam shall be highly tempered extruded aluminium alloy construction which shall resist any deformations even after repeated use.

4.3.8 The same vulcanizer should be capable of vulcanising a range of different belt widths & different ratings.

5.0 INSPECTION AND QUALITY CONTROL

5.1 Special material

The manufacturer should furnish during inspection, without extra charge, test certificates covering mechanical properties and chemical composition for special raw materials used including that of liners. The certificates should be from the approved testing laboratories like CMERI-Dhanbad, NPL-New Delhi etc. If considered necessary, samples for such material and components may be selected as per IS: 1548 (current) by the employer's representative from amongst the raw materials and manufactured components of equipment and tested in the approved laboratory. In case samples so selected fail to meet the standard specifications, the whole lot of the manufactured components will be rejected and disqualified for use again for any CIL supplies.

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6.2 Following minimum NDT requirements to be ensured for welds:

i) Butt welds : 10% Ultrasonic / Radiographic and 100% Magnetic particle

ii) Fillet welds : 10% Magnetic particle
Miscellaneous Equipment

The following items will be provided wherever necessary throughout the Coal Handling Plant

1. **Hoists for Maintenance**

   Installation location of hoists are mentioned in Appendix ‘C’.

1.1 **Electric Hoist**

   These will be mono block type suitable for system requirement. They will be fitted on rollers travelling on suitable I – section. They will be located over the, take-up locations, drive locations and apron feeder, sampler, and above silo.

   The units will have two motions, one for lifting and lowering and the other for traversing forward and backward on I-section.

   This device will be floor operated and will be placed over the overhead structures so that it covers the whole floor.

   The capacity, lifting height, traversing distance, lifting speed and other technical parameters will be selected to suit the system designs. The supply will also include complete unit including power supply and structural portion.

   The gear unit will consist of helical gear pinion. The gear unit provided shall be of reliable & maintenance free type. There will be a limit switch at highest and lowest positions of hook so that the hoist is protected from any damage due to over travel of the hook. The drum will be of fabricated steel construction having very high tensile strength. The drum should be provided with smooth machine-cut grooves. The hoist motor will be fan cooled rotor brake motor conforming to international standards.

1.2 **Chain pulley block**

   In addition to the provision of electric hoists, chain pulley blocks of suitable capacity will also be provided at drive houses and tail ends for effective maintenance of the equipment. The number and capacity will be fixed during detail design stage. The chain pulley block shall have chain & wheel facility to move in horizontal and vertical locations.

   The effort required at pulling chain will not be more than 25 kg at full load and speed. The hanging structures will have an outside projection for easy handling of material. The supply will include complete chain pulley block with hanging structure.
1.3 Load Test

All hoists and hoisting systems will be load tested to the relevant Indian Standards before use and test certificates provided.

1.3. Flap Gate

2.1 Motorised Flap Gate

The flap gate of the bifurcation chute (in the transfer houses at the end of conveyor (C2) shall be of robust construction and will be actuated by an approved motor operated with reduction gear actuator. The motor will be completely dustproof and its starting will be such as to provide sufficient thrust for operation of the flap gate against the falling weight of coal. The flap gate will have locking arrangements for two extreme positions and a suitable intermediate position. The flap gate assembly will be mounted with bolted connection for easy replacement. It will consist of MS plate lined with rubber liner or suitable thickness on either side. The flap gate will be mounted on a shaft which in turn will be mounted on anti-friction bearings. The bearing housing should be dustproof.

Dust and explosion proof switches of an approved manufacture suitable for use with 230 V, 50 Hz., AC supply will be provided.

The equipment will be capable of being operated for at least fifteen switching per hour. Provision should be made for remote control (i.e. from the control room) but it will have a local control also. Apart from this, provision for manual operation of the flap gate should also be incorporated.

2.2 Location

Motorised flap gate
i) Conveyor C2: At TRIPPER.

2. Chutes And Liners

3.1 All the transfer chutes will have a sloping angle of 55 degree. The chutes will be constructed in such a way that no off centre loading on the belt takes place and material is fed in the direction of the motion of belt. The chutes will be fabricated from 10 mm thick MS Plates by electric welding as per relevant IS Code of practices. These will be provided with necessary stiffeners and brackets for supporting from the adjacent structures.

The high impact zone (primary impact) of the chute, where material directly impacts from discharge pulley, shall be provided with abrasion resistant steel (having BHN 500) impregnated with rubber liner with steel backing plate. At secondary impact zone, the liner shall be provided with steel backing. In addition all rubber liners shall be steel-backed. For the flow zone at discharge end, ceramic cylinder embedded rubber shall be provided to enhance flow area.
The minimum thickness of the synthetic/rubber liner will be 40 mm and it will have the shore hardness of 68 ± 5 Shore A. The liner plate will be high pressure moulded to ensure uniform curing of thick sections. For all impact areas, the liner plates will be of standard size and replaceable plate wise for ease of maintenance. For non-impact areas, where only fine particles of coal are supposed to fall should be lined with polymer liner plates of suitable thickness.

3.2 The liners will be fastened with a flexible system to minimise instantaneous impact and hence reduce the wear rate. The fastening system will be either through bolting or stud welded bolting for quick installation. For all impact areas the bolt heads will be protected by a rubber plug.

3.3 The liners are meant to be used in the chutes which may have to handle crushed coal lumps up to 250 mm in size. The other parameters like speed, capacity height of all etc. can be seen in data sheet of conveyors and drawings. The crushed coal may contain sandstone and shake up to 30%. During the rainy season the material will have considerable moisture. The liner should be designed keeping all the above things in view. The liner thickness should be designed to give a minimum guaranteed life of 15 million tonnes of coal handled. The working atmosphere will be dusty, temperature will range between 4 °C and 50°C and relative humidity up to 100%.

Care shall be taken so that the trajectory of coal coming from the belt does not impinge excessively on the side of the chute.

4.0  Sump Pump

Sump pump will be provided complete with drives, control system, pipes, valves etc. The pumps will be non-clogging type and will automatically stop and start at specified low and high levels of water in the drain pits respectively.

The pump will be slurry pump of minimum 50 m head and discharge 10 LPS with stainless steel impellors. The pumps should be also to draw water from specified locations and should be able to pump in to the drainage system of the project or plant.

The pumps should be capable of handling slurry mixed with coal particles up to max.15 mm size.

The casing will be of abrasive resistant casting with BHN not less than 300. The pump casing will be submerged in the sump while the motor would be placed on the floor above. However, a drawing showing the complete arrangement of the system should be furnished.

The suitable size of inlet and outlet, type of foot valve strainer, heavy duty GI pipes, hoses and other valves should be used. Sump pump will be located at following locations.

All piping dealing the water whether for plant cleaning, fire fighting, dust suppression, etc. will be of heavy duty GI.
1.0 Dust Suppression

Automatic Fog type dust suppression system employing water has been envisaged to minimise the water consumption. This will be done by spraying of water to form a misty atmosphere over the open space. The system should be suitable to work with the available plain Industrial water received through IWSS circuit.

The DS system is to be designed for conveyors falling within the scope of this tender and not for the future conveyors. Wherever there are two streams of conveyors DS system will be designed considering simultaneous operation of both streams of conveyors. For receiving pit independent system shall be provided.

The automatic dust suppression system will be complete with necessary pump, heavy duty GI pipes, valves, supports, spray nozzles, flanges, bolts, nuts, gaskets, bends, etc.

Each lot of dust suppression system will consist of the following:

1) 1 number dust suppression sump of sufficient capacity. The sump will be fabricated from 6mm thick MS plate. Necessary overflow and drain for the sump should be provided.

2) 2 numbers dust suppression pumps out of which one will be working and the other will be stand by. This pump will pump the water from dust suppression sump to spray points.

3) Pipe valves, nozzles and auto control as per requirement.

5.1 System to be incorporated will be as follows

Controlling quantity of water will flow from industrial water tank to dust suppression sump. The level in the dust suppression sump will be automatically controlled by the level controller provided with the sump. Spray nozzles will be installed at different locations to achieve misty atmosphere formation.

5.2 Locations will be as follows

i) All conveyor transfer points/discharge points.

ii) Receiving pit top.

iii) Silo top (fixed type)

6.0 Dust Extraction System

The objective of this system is to extract coal dust from various dust generating points, and clean the dust laden air by trapping dust particles and finally discharge clean air into the atmosphere, so that dust concentration at the dust generating points, even under the critical/worst operating condition is less than 3 mg/m$^3$ of air and at emission point in atmosphere it will be within permissible limits of 150 mg/normal m$^3$ of air.

The dust extraction system envisages dry type dust collectors to suit the system requirements. This will include net work of suction hoods and ducting connected to a wet type collector for separating dust from the air stream. Air outlet of collectors
will be connected to a chimney so as to discharge clean air to atmosphere. Collected dust from collector will be directly discharge, on the nearest belt conveyor through its rotary feeder. Dust concentration with particle size distribution norms to be followed i.e. ACGIH or any other norm.

6.1 Dust Collector
For each dust extraction plant adequate number of dust collectors for arresting the dust from laden air will be provided. The efficiency of the collectors will be sufficient to meet the system requirements.

6.2 Air Exhaust Fans
This will be of centrifugal type with radial bladed impeller. The fans will be of robust construction. The fans associated with dust extraction system will be designed for adequate duty keeping margin of approx 25% on pressure rating. This will be manufactured vibration free in operation and designed to limit noise Level to 72 decibels. The fan and motor will be rated for continuous operation.

Relevant IS (in its absence, BS or other approved code) of engineering practices will be employed for the design and Construction of impeller, shaft, bearing, etc.

6.3 Dust Collecting Hood
Necessary dust collecting hoods and MS sheet ducting of adequate size and design will be provided for guiding coal laden air from dust generating points to wall cyclone separators, and dust free air from cyclone to atmosphere via extraction fans. The clean air from the fan will be taken to suitable height (not less than 9 metres or 1.5 m above height of roof in the vicinity, whichever is more) before discharging in to the atmosphere.

The following considerations will be taken care of while designing the hood and ducting system:

a) The hood connections will be designed for collecting the dusty air from various dust generating sources.

b) Centre line of hoods will be located at the point of generation of maximum pressure.

c) The hoods will be adequately sized to collect all dusty air generated at the point and velocity in the hood should not be so high as to draw large size particles unnecessarily.

d) The ducts for conveying dusty air will be of round shape and of streamlined for efficient airflow.

e) The velocity of air in the duct will be high enough to transport suspended dust in the air.

f) Flexible connections will be provided at the duct connections to inlet and discharge of the fans.
g) Adequate duct supports will be provided at proper places.

h) Thickness of ducting will be 3 mm on the straight and 2.5 mm on bends (min.).

i) Supporting structure for the entire system anchor bolts, staves, hangers, dampers, regulators, vibration isolators, etc. as required for the work will be provided of adequate size and design.

Locations

e) Receiving pit top.

ii) Tripper of conveyor C2

iii) Crusher feeding point.

iv) Apron feeder discharge point.

7.0 Plant Ventilation System

Motor control center will be provided with suitable ventilation system. The ventilation system incorporates both the supply and exhaust of air system. The system will include suitable air filter for supply of fresh air in side the tunnel, air fan, exhaust air duct with grills etc. The number of air changes per hour will be minimum 15.

i) Radial blade fans or backward inclines (backward curved radial tripped impellers.) fans shall be used.

ii) Environmental data for design of ventilation and air conditioning system. shall be collected before tendering from the site.

iii) Dry panel or auto viscous type filters for pressurised ventilation systems shall be used.

iv) Wall mounted tube axial for pressurised ventilation system or centrifugal fans are required.

v) Dust concentration at work zone. shall not be more than 3mg/m³

8.0 Noise and vibration control

It is well accepted of that noise pollution causes fatigue to operation personnel. Every effort will be made to keep down the noise Level to the extent it is feasible. All machine mounting will have suitable arrangement for reducing the vibration and thereby noise. All transfer chutes within synthetic/Rubber lining. The noise level near the noise generating points will be maintained below 75 dB as per relevant Indian/International standards.

9.0 Plant cleaning facilities

To facilitate efficient plant cleanings, at strategic locations, adequate number of high pressure water points have been envisaged. These service points will be provided with quick connecting hose coupling for easy fixing and dismantling of hoses. These
service points will be so located that with a 15/20 m long hose, any working area in the plant of a equipment can be reached. Pipe line will be laid with heavy duty GI pipe only.

To handle discharge from plant effluent and floor washings of the plant area, suitable drainage system will be provided. These will be located at required locations. Plant effluents will discharge through open drains or pipes into the existing pond for further treatment so that all residues and solids remaining in the water are within permissible limits before the same is discharged into nearby nallahs.

10.0 **Condition Monitoring System**

The scope includes the on-line Monitoring system for CHP. The requirement can be classified into two categories like:

a) Bearing Monitoring system (BMS).
   - For Monitoring the anti-friction bearing temperature in the CHP.
b) Vibration Monitoring system (VMS)
   - For monitoring the general machine vibrations.

10.1 **Bearing Monitoring System**

This on-line monitoring system will monitor the machine conditions through the shock pulse signal obtained from the transducers to be fixed on the different bearing points. The in-put thus obtained from the transducers will be processed with the help of system software.

10.2 **Vibration Monitoring System**

This monitoring system will measure the vibration of the machine through transducer mounted on the machine strategic points and operated through software control.
1.0 Safety Precautions and Provisions

1.1 Access Handrails, intermediate rails and toe-boards shall be fitted to all sloping walkways and walkways from which a person is likely to fall a distance of more than 2 m on the side remote from the conveyors in addition to any handrail which may be required to guard the conveyor. The top rail shall normally be 1 m above the level of the walkways. A toe board shall be placed at floor level, on walkways and stairways. With respect to the height of toe boards attention is drawn to the requirement of legislation relevant to the application.

Access underneath the conveyor, where the clearance is greater than 700 mm and less than 2 m or where there is a danger of person falling into an open space shall be prevented by suitably placed rails. Where access is allowed underneath the conveyor guarding shall be provided.

1.2 Guards shall be provided at all nip points where belts wrap around pulleys and at nip points occurring at accessible carrying and return idlers at or near convex curves and at other points where an upward movement of the belt may be restricted by means other than the load (such as at loading points chutes and skirt plates). Guards shall either prevent access to the nip point or extend at least 1 m from it.

1.3 Guards shall be provided at and shall totally enclose, rotating shafts and couplings, chains and chain wheels, gears and power transmission belts and pulleys.

Guards may be of perforated or imperforated construction and shall be of adequate rigidity and strength for the situation in which they are employed if of perforated construction, they shall comply with the requirements of 1. 4&1.5. If any openings are provided for the insertion of cleaning bars they shall comply with the requirement of 1.4 If any openings are provided for the insertion of cleaning bars they shall comply with the requirements of 1.5

Guards shall be securely fixed in position and shall be capable of being removed and replaced without dismantling any other part.

1.4 Size of mesh or openings (Other than for Cleaning Bars) and clearance:

Perforate guards may be manufactured from perforated sheet, expanded metal woven wire, metal lattice or similar materials and the openings in such guards (other than for the insertion of cleaning bars) and the minimum clearance between the guards and any moving parts shall be in accordance with the requirements of table given below:

1.5 Opening for Cleaning Bars:

Slots not exceeding 30 mm wide and suitably reinforced, may be provided in guards for the insertion of bars for cleaning. The minimum distance between any moving part of the conveyor and any part of the slot shall be 300 mm.
1.6 Travelling Trippers:

1.4 & 1.5 apply to travelling trippers. In addition the following requirements apply:

**Access:** Where there would be danger of trapping a person between a moving tripper or shuttle conveyor and any fixed object other than its track, there shall be a minimum clearance of 460 mm

**Guards:** Provision shall be made to prevent any trapping between the travelling wheels and the rails. Rail clamps shall be provided for the trolley of tripper for safety purposes.

**Emergency Stopping and Safe Re-Starting:** Suitable means shall be provided for stopping the conveyor in an emergency at any point throughout its length. Provision shall also be made for safe re-starting.

1.7 The whole conveyor path, especially the loading, unloading and transfer points shall be designed to avoid spillage of conveyed material as much as possible. Zero spillage shall be aimed in places where the conveyor path is passing over areas in the steel plants in which personnel work or frequent.

1.8 Conveyor belts shall be of sufficient width to suit the designed load requirement for the material to be conveyed. Guiding and centring devices shall be provided for the material at the feed points and along the belt at suitable locations.

In case of inclined conveyors, the slopes and characteristics of conveyors shall be selected so as to avoid slipping and / or dropping of the conveyed product under normal working conditions.

1.9 To prevent running backward or forward of inclined/declined conveyors, a safety device shall be provided. Belt conveyor components shall be suitably guarded.

1.10 **Safe Access:** Provisions laid down in IS-7155 : 1974 shall be followed. The design of galleries and tunnels shall be in accordance with civil scope of works. Sharp edges and corners shall be avoided in the areas normally accessible to personnel between the floor and a height of 2 m.

1.11 Sequence interlock shall be provided at every loading point, discharge point, etc. so that no conveyor is able to feed material to a conveyor or hopper which is in operative or has reached its full capacity.
1.12 Audible or visual signals shall be provided along the length of conveyors so that operator is able to give adequate warning to personnel in the vicinity of conveyor installation, about the imminent starting of conveyor system.

1.13 In case of mobile trippers and shuttle conveyors, the area of travel shall be suitably guarded and these shall be provided with warning signs and appropriate audio visual warning system for use before starting the conveyor/tripper.

1.14 Inspection door shall be provided in hoppers and chutes.

1.15 Adequate lighting provision shall be provided in galleries and junction houses for natural lighting. For night operations, the lighting arrangements shall conform to IS:3646-1986 ‘Code of Practice for interior illumination: Part 1 Principles of good lighting and aspects of design, IS:3646-1968 ‘Code of Practice for interior illumination Part 3 calculation of coefficients of utilization by the BZ method’

16.0 Fire Protection: Adequate fire protection facilities such as fire alarms and adequate no of fire extinguishers shall be provided at all junction houses, galleries, sub-stations etc.

1.17 Adequate ventilation facilities shall be provided to protect men and equipment.

2.0 Marking of Controls:

2.1 All controls shall be marked with the words appropriate to the function they control, such as stop, start, forward, reverse, raise or lower. Arrows indicating the direction of travel control shall be provided at all forward and reverse controls.

2.2 Location of signs – Each stop control shall be readily accessible and shall be indicated by a standard or uniform type signs erected in suitably conspicuous positions and shall have letters not less than 15 mm high.

2.3 For pull cord controls, signs shall be erected at suitably and clearly visible positions along the length of the conveyor, or at any other location where pull cord is installed, at intervals not greater than 30 m apart and labelled Conveyor Stop.

2.4 Communication – Suitable means for communication from each conveyor head end and junction tower to various offices shall be provided. For this public address system (speakers at various points with microphones at important locations) may be adopted.

3.0 SAFETY GUARDS:

3.1 Guards shall be designed to prevent injury to persons and shall be provided at every dangerous part of equipment normally accessible to personnel. They shall be designed to form part of the equipment and shall not in themselves create hazards.

3.2 Guards shall be provided to prevent accidental contact by persons or parts of clothing being caught in equipment. All guards shall comply fully with the requirements of the relevant statutory authority.

3.3 All sheet metal guards shall be aluminium. All guards shall be painted safety yellow.

3.4 Lifting handles or lugs shall be provided where required for the safe removal or opening of guards.

3.5 The tops of coupling guards and brake guards shall be readily removable by hand by one person without the use of tools.
3.6 It shall be possible to inspect brakes for adjustment, lining wear, etc., without prior removal of brake guards being necessary.

3.7 Name plates, warning signs or other data affixed to drive components shall not be obliterated or covered by parts of the guards.

3.8 Where removal of the guard is infrequent for inspection or maintenance purposes, it shall be fixed in position so that it can not readily be removed without the use of tools.

3.9 Fixed guards shall be provided where the equipment can be serviced without the removal of the guards. Removable guards or removable inserts to fixed guards shall be installed where normal maintenance, “V” belt tension inspection or cleaning is carried out. These shall be installed in a manner acceptable to the relevant Statutory Authorities and shall be clearly labelled: “DANGER ISOLATE DRIVE BEFORE REMOVING GUARD”.

3.10 Design and construction of guards, personnel reach dimensions and acceptable distance between guards and danger points shall be as defined by relevant standards or statutory requirements.

3.11 Where required for inspection or maintenance purposes, hinged inspection doors may be provided in the guard, hinged in such a way that there will not be a tendency for the door to be left in the open position.

3.12 Guards shall provide for tachometer access to rotating shafts.

3.13 Guards with any dimensions in excess of 1800 mm shall be easily assembled in component parts that do not exceed 60 Kg mass. All component parts of the guard shall interlock together to form a rigid and safe assembly.

3.14 Guards on conveyors shall be designed, constructed and installed in accordance with relevant Indian Standard.

3.15 Solid sheet metal guards shall be provided for all fluid couplings which are provided with fusible plugs. A catch tray having a capacity of at least 125 % of the maximum fluid capacity of the coupling shall be provided beneath the guard and coupling. Should guard ventilation be necessary, this shall be provided on the opposite side to the fusible plug.

Other sheet metal guards shall be provided with at least one mesh panel at the upper part of the guard to allow ventilation and inspection of the guarded components. Location of this panel shall not allow water drip or splash to enter the guard. V- belt guards shall have solid edges and mesh sides to ensure V- belt ventilation.

4.0 SAFETY AND IDENTIFICATION SIGNS:

4.1 Safety and identification signs shall be placed on all equipment, conveyors and work areas. All signs shall be painted with luminous paint on 2.5 mm minimum thickness brass or stainless steel sheet.

4.2 Identification signs shall be bold lettering (minimum of 50 mm high) on a white background. Each item of equipment shall be clearly identified with a minimum of two signs.

4.3 Conveyors shall also have signs to identify (These signs shall be located on both sides of the conveyor).
a. Head location  
b. Tail location  
c. Take up mass tonnes  
d. Drive number  
e. Conveyor number at 20 m intervals along the conveyor

4.4 All equipment and work areas shall have signs for:
   a) Hearing protection  
b) Warning that equipment may start without notice  
c) High voltage  
d) Eye protection.

5.0 Maintenance facilities in conveyor system

5.1 Sufficient space shall be provided for replacement of pulley by lifting it vertically above its mounting. In case of constraint of head room sufficient space shall be provided on the non driving side of the pulley so that the replacement of the pulley can be done from that side of the pulley. In such case minimum clear space shall be equal in the length of the pulley over its shaft plus 500mm.

5.2 A minimum 1000mm clear space around drive mechanism shall be provided.

5.3 A suitable platform near expansion joint gallery for inspection and maintenance of supporting rollers and connected parts.

6.0 Hoisting Mechanism

6.1 Hoisting mechanism shall be used in activities such as replacement over haul of drive pulleys, gear boxes, motors, etc. the mechanism shall be appropriate for handling different heights.

6.2 At the tail end of the conveyors a suitable lifting beam shall be provided.

6.3 Suitable lifting facility at intermediate locations along the conveyor shall be provided if required.

6.4 Lifting beam shall be provided above the take-up pulley of vertical gravity take-up unit.

6.5 The individual weights of the take-up unit shall be easily replaceable by manual effort and shall not weigh more than 50 Kg. each.

7.0 Replacement of belts.

7.1 The methodology of replacement of belts in conveyor system shall vary for different layouts. Sufficient space behind the tail end shall be provided so that the new belt can be spread there suitably. In place where spreading of belt would not be necessary provision for anchoring the stand (for keeping the roll of the belt) shall be made. The roll stand shall be designed taking into consideration the width of the belt, the maximum diameter of the roll and the maximum weight of the roll.

7.2 Idlers and guide rollers shall be provided behind tail pulley, counter weights structures and opening through which the new belt would enter the gallery to ensure smooth mounting and minimising possibility of damage to the new belt.
7.3 The suspenders of the counter weights of the take up units shall be located at a distance not less than belt width plus 100 mm.

7.4 In case of under ground conveyor and other conveyors, where ever required suitable opening matching with the centre line of the conveyor shall be provided for introducing the new belt and removal of used belt.

8.00 General Provisions:

8.1 Suitable provision for suppression and extraction of dust shall be made

8.2 The design of the bearing blocks and the side cover permit visual inspection of the bearings

8.3 Suitable inspection schedule for preventive maintenance shall be furnished.

8.4 Provision of Sump, Pump for dewatering of under ground premises and suitable sweep chutes for disposal of fine dust from the floors shall be made.
1.0 SCOPE

For determining the quality of coal despatched by each rake there shall be provision of automatic sampling of coal from the coal streams of in feed conveyors to the silo. The sampling system shall conform to BIS / ISO / ASTM specifications and shall consists of a primary sampler fitted to each in feed conveyors and a primary sample belt feeder.

2.0 APPLICABLE STANDARDS AND CODES

The equipment shall be designed and manufactured in accordance with the latest revision of BIS. Where ever BIS are not available, British standard/American standard/DIN/JIS or any other equivalent superior standard shall be followed. Any amendment/revision in above standard that may be in force during the period of manufacture shall also be taken into consideration.

Besides the above, the equipment covered under this specification shall comply with the requirement of all latest applicable statutory acts/regulations which may be in force during the period of execution and which are related with design, construction, and operation of the equipment in their location where it will be installed.

3.0 DUTIES

The cutter device employed in the sampling system should have an opening four times the top size of the material to be sampled. The sampling device should be designed to minimise disturbance of the coal flow while rotating/sweeping over the stream. The cutter shall rotate/sweep the material at a constant speed. There shall be one belt/chain feeder conveyor of min 650mm to collect coal samples from the two separate sample discharge chutes and to convey the primary sampled coal to the existing sampling system.

4.0 DESIGN & CONSTRUCTION FEATURES

4.1 There shall be 2(two) primary sampler cutter fitted suitably to each of the in feed conveyor for sampling of coal.

4.2 The arm/structure of sampler cutter shall be fabricated with MS plates and lined with abrasion resistant stainless steel liner.

4.3 The sample cutter shall be suitably designed to extract representative Samples from the stream of coal of size up to 250mm.
4.4 The type and size of the cutter, cutter speed shall be selected to suit the duty condition and these shall be clearly indicated in the offer separately for both the options.

4.5 The cutter chute opening shall be minimum 4 times the coal size and it shall be of sufficient depth and designed to avoid any loss of sample.

4.6 The sample cutter shall pass through the stream always at right angles to the flow and must travel at constant speed which shall not exceed 0.6m/sec.

4.7 The cutter arm shall be removable for wear replacement, there shall be no protruding bolts or obstructions on coal contacting surfaces and corners of the liner shall suitably reduced.

4.8 The primary sampler drive shall be direct motor drive of mechanical type.

4.9 Adequate means such as dust doors or baffle plates shall be incorporated to ensure the sample cutter is in the park position.

4.10 Inspection doors to observe sample

4.11 Frequency of sample increment shall be in accordance with BIS / ASTM/ DIN standard.

4.12 There shall be one belt / chain feeder conveyor of minimum width 650mm to collect coal samples from the two separate discharge chutes and to convey the primary sampled coal to the existing sampler hopper of stage-I silo.

4.13 **The belt feeder shall be complete with head and tail sections.**

5.0 **BASICDATA**

5.1 Type of Sampler Cutter : Sweep type / Barrel type

5.2 Type of cutter drive : Positive, mechanical drive

5.3 Motor power : As required for the System duty

5.4 Material construction : M.S. and replaceable stainless steel arm

5.5 Arm rotation & constructional features : As per design requirement which facilitate no spillage during operation

5.6 Mounting : Directly to conveyor with strl. Steel.

5.7 Lump size to be handled : ( - ) 100mm

6.0 The sampling system shall be provided with electrical control system with timers etc to provide for automatic start up. The sampling system shall be interlocked to the silo in feed conveyors. The electrical system shall be complete with motor control centre, relay panel control, console with graphic display and auxiliary equipment as per latest international practice.
7.0 Primary Sample Belt Feeders: There shall be one screw conveyor of minimum diameter 650 mm to collect coal samples from the discharge chutes.

The screw feeder shall be complete with head and tail sections, drives, skirting, adjustable feed gate, infeed and outfeed sections, conveyor belting, etc. The complete system shall be designed to suit the duty requirement and to feed the metered amount of coal to the subsequent sampling stations without loss of fines or moisture. The belt conveyor shall be sealed by skirting at the feed point and totally enclosed.

A screw take up and pulley scrapper are also to be provided the feed hopper shall be design to empty completely with no possibility of sample retention.

8.0 Blas connections: There shall be blas connections in the chute between the belt feeder and crusher. This connection shall be utilised for collecting the primary sampled coal into the Employer' container.

9.0 Sample Crusher: The sample crusher module shall be designed to reduce from (-)100 mm size coal to minus 8 mesh without loss of fines as well as moisture. The crusher may be of single stage or double stage type, depending upon the type and size of crusher.

10.0 Secondary Sampler: The crushed product shall be fed to the secondary sampling machine through a belt feeder. The secondary sampler shall be designed to suit the duty requirement and shall be installed between the inter-connect chute works. The internal surface coming in contact with the coal stream shall be lined with abrasion resistant stainless steel liner plate. The sampler shall be complete with cutter Driver, flanged chute connections etc. The secondary sampler drive shall be designed to take a representative sample of the crusher discharge. It shall operate through the coal stream in a manner straight to primary sampler. Sampler cutter speeds shall not exceed 0.8 M/Sec. Minimum number of increments shall be six times the number of the increments. The secondary sampler shall be modular type with self contained enclosure. Sample drive may be hydraulic or mechanical. The sampler cutter shall move through the angle stream at right angles to the flow areal and slot type feeders are not acceptable.

11.0 The cutter opening for fine coal shall not be less than 30 mm. In the tertiary sampler, the minimum size of sample shall not be less than 100 gms/cut and increments shall not be less than 60 (sixty) per hour.

12.0 Sample Collection: This shall be 8 (eight) stations rotary sample collector. The sample shall be collected in dust and moisture tight plastic containers with proper fittings for engagements and removals. The rotating table shall be driven by geared motor drive system.

13.0 Reject Bucket Elevators: The rejected coal from the sampling system shall be fed back to the hopper through bucket elevator. The bucket elevators shall be of centrifugal discharge type having buckets bolted on elevator belting. The bucket elevator shall be complete with drive, motor, reduction gear box, head end tail pulley etc.
14.0 Sample System Chute: All chutes within the sampling system including reject elevator discharge chute to the hopper shall be fabricated from mild steel and lined with abrasion resistant triscal liner. All chutes shall have a minimum valley angle of 45 degrees.

15.0 Sampling System Control: The sampling system shall be provided with electrical control system with timers etc. to provide for automatic startup. The sampling system shall be inter-locked to the Silo infeed conveyor. The electrical system shall be complete with motor control centre, relay panel control or PLC based console with graphic display and other auxiliary equipment as per relevant standard and latest international practice.

16.0 INSPECTION AND QUALITY CONTROL

16.1 Special material
The manufacturer should furnish during inspection, without extra charge, test certificates covering mechanical properties and chemical composition for special raw materials used including that of liners. The certificates should be from the approved testing laboratories like CMERI-Dhanbad, NPL-New Delhi etc. If considered necessary, samples for such material and components may be selected as per IS : 1548 (current) by the employer’s representative from amongst the raw materials and manufactured components of equipment and tested in the approved laboratory. In case samples so selected fail to meet the standard specifications, the whole lot of the manufactured components will be rejected and disqualified for use again for any CIL supplies.

16.2 Stage Inspection

The Employer reserves the right to carry out inspections at any stage of the process of manufacture and assembly for which all facilities will be provided by the manufacturer. Before carrying out such inspections, necessary advance information will be given to the manufacturer.

16.3 Availability of standard specification Meters, Gauges, etc. for testing and inspection

The manufacturer will maintain all relevant standards and codes of practices for manufacture, inspection and testing of components of the equipment ordered. He will also maintain a set of meters and gauges etc. as may be required for testing and inspection of components.

17.0 CHECKS DURING INSPECTION

The details of the checks to be carried for various components are to be submitted by the contractor for Owner’s approval. However, some indicative checks on different items are given below which should necessarily form part of the quality assurance programme to be agreed with the Owner.
17.1 All plates above 20mm thickness to be ultrasonically tested for laminations. Shaft forgings and castings to be checked for hardness, microstructure and ultrasonic testing in addition to check for chemical and mechanical properties.

17.2 Following minimum NDT requirements to be ensured for welds:
   i) Butt welds: 10% Ultrasonic / Radiographic and 100% Magnetic particle
   ii) Fillet welds: 10% Magnetic particle
SAMPLE FEED SCREW CONVEYOR

1.0 SCOPE

Sample feed conveyor shall be one belt feeder conveyor of min 650mm or chain conveyor to collect coal from the two separate sample discharge chutes and to convey the primary sampled coal to the sampling system of existing silo. The system shall conform to BIS / ISO / ASTM.

2.0 Applicable standards and codes

The equipment shall be designed and manufactured in accordance with the latest revision of BIS. Wherever BIS are not available, British standard / American standard / DIN / JIS or any other equivalent superior standard shall be followed. Any amendment / revision in above standard that may be in force during the period of manufacture shall also be taken into consideration.

Besides the above, the equipment covered under this specification shall comply with the requirement of all latest applicable statutory acts, regulations which may be in force during their period of execution and which are related with design, construction and operation of the equipment in their location where it will be installed.

3.0 Primary Sample screw feeder

There shall be one screw feeder conveyor of min. dia 650 mm to collect coal samples from the two separate sample discharge chutes and to convey the primary sampled coal to the sampling system. The screw feeders shall be complete with head and tail sections, drive, skirting, adjustable feed gate in feed and out feed sections, conveyor belting associated electrical and control system etc. The complete system shall be designed to suit the duty requirement and to feed the measured amount of coal to the sample crusher/secondary sampler without loss of fines or moisture. The belt conveyor shall be completely sealed with dust tight enclosures. A screw take up at tail end and belt cleaner on discharge pulley are also to be provided. The belt shall be fitted with variable speed drive for local manual adjustment and an adequate means of adjusting the bed depth using a striker gate at the feed hopper discharge. These adjustments shall be adequate to ensure no contamination of one sample increment with the next following increment, otherwise also this has to be insured. The feed hopper shall be designed to empty completely with no possibility of sample retention.

Number of belt feeders : 1 (one)
Capacity : 6 tph (approx.)
Belt width : 650 mm
Belt speed (nominal) : 1.25 m/sec (approx.)
Material size ; 100 (mm)
Drive power ; As required for system duty
Belting type ; M 24 grade rubber belt cover thickness, top 3 mm, Bottom – 1.5 mm.

4.0 INSPECTION AND QUALITY CONTROL

4.1 Special material
The manufacturer should furnish during inspection, without extra charge, test certificates covering mechanical properties and chemical composition for special raw materials used including that of liners. The certificates should be from the approved testing laboratories like CMERI-Dhanbad, NPL-New Delhi etc. If considered necessary, samples for such material and components may be selected as per IS : 1548 (current) by the employer's representative from amongst the raw materials and manufactured components of equipment and tested in the approved laboratory. In case samples so selected fail to meet the standard specifications, the whole lot of the manufactured components will be rejected and disqualified for use again for any CIL supplies.

4.2 Stage Inspection
The Employer reserves the right to carry out inspections at any stage of the process of manufacture and assembly for which all facilities will be provided by the manufacturer. Before carrying out such inspections, necessary advance information will be given to the manufacturer.

4.3 Availability of standard specification Meters, Gauges, etc. for testing & inspection
The manufacturer will maintain all relevant standards and codes of practices for manufacture, inspection and testing of components of the equipment ordered. He will also maintain a set of meters and gauges etc. as may be required for testing and inspection of components.

5.0 Checks during inspection
The details of the checks to be carried for various components are to be submitted by the contractor for Owner’s approval. However, some indicative checks on different items are given below which should necessarily form part of the quality assurance programme to be agreed with the Owner.

5.1 All plates above 20mm thickness to be ultrasonically tested for laminations. Shaft forgings and castings to be checked for hardness, microstructure and ultrasonic testing in addition to check for chemical and mechanical properties

5.2 Following minimum NDT requirements to be ensured for welds:
i) Butt welds : 10 % Ultrasonic/Radiographic and 100 % Magnetic particle

ii) Fillet welds : 10% Magnetic particle
SPECIFICATION OF CONDITION MONITORING SYSTEM

1.0 Scope

This specification covers design manufacture, erection, testing and commissioning of a permanently installed, continuous condition monitoring system, consisting of transducers, converters and combined display and control modules with online data evaluation. The system offered shall be in successful operation for at least two years after successful commissioning. Necessary documentary evidence in respect of satisfactory performance shall be submitted with the offer.

2.0 Compliance with standards

The design, selection, and construction of equipment, components and material shall conform to relevant Indian Standard Specifications and Codes of Practice incorporating the latest revisions or in their absence to equivalent BS/DIN/AMERICAN Standards.

3.0 General Construction Features

3.1 This shall be a permanently installed continuous machine condition monitoring system (CMS) comprising of sensors/ transducers, converters, combined display and control modules/units. CMS shall use permanently attached sensors, provide continuous monitoring, provide early detection and protective action against critical machinery. The software shall aid in collection, management and analysis of machinery. The software provided shall be of latest version and proven track record of successful operation.

3.2 The system shall comprise sensors/ transducers/ other accessories permanently attached to strategic measurements in the machinery. The sensors shall measure bearing condition, vibration severity, temperature and RPM.

3.3 The CMS system shall be complete in all respect with adequate quantities of transducers, local monitoring units, display units, necessary system interface, cables/ coaxial cables, connectors, necessary soft wares and hard wares and other accessories.

3.4 All field monitoring and display units, transducers, cables, connectors and other accessories shall be suitable for operation in harsh environment (highly laden with coal dust, moisture and slurry) of coal handling Plant and having ambient temperature of 55°C. The housing shall be made of corrosion resistance material like polycarbonate, stainless steel etc. as may be required to suit the design. The cable inlets shall be nickel plated brass with neoprene gaskets. Class of Protection shall not be less than IP65. The Transducers shall be housed in corrosion resistant material like stainless steel. The transducer lines shall also be monitored for transmission quality.
3.5 The software offered shall

i) store data, using a customer defined numbering system, and evaluate measured results from all instruments for periodic bearing condition, vibration severity and vibration analysis.

ii) controls the CMS system for continuous condition monitoring

iii) administer measuring, lubrication, inspection and other maintenance routines

iv) produce alarm lists and graphic displays of measuring results, analysis results etc.

3.5 The minimum hardware configuration (reputed make) along with operating system shall be as follows:

i) PC with latest configuration, min. 320 GB HDD, and 2GB RAM Integrated graphics with AGP slot, CD/DVD-RW and 19” monitor.

ii) Desk jet /inkjet printer, 1200 dpi

3.6 The CMS system shall be provided for all drives above 110 kW, sizer, secondary crusher, apron feeder and hydraulic power Pack of Rapid loading System.

3.7 The installation of CMS system shall be under the strict supervision of the CMS supplier/manufacturer, whose system are already in satisfactory operation for at least two (2) years.

3.8 Inspection/checking

The system will be checked during preliminary acceptance of the Plant & Equipment.
SP/M-21

ROTARY PLOUGH FEEDERS

Basic Parameters

a) Capacity : 1200 TPH average
b) variable capacity : 900-1800 tph
c) Material to be handled
   i) Material : Crushed coal containing shale & sand stone up to 30%
   ii) Size : (-) 100 mm.
   iii) Moisture content : Inherent moisture 7 to 10% during rainy season there may be considerable amount of surface moisture in the coal and this may be up to 20%.
   iv) Bulk density : 0.8 for volume calculation & 1.15 for load calculation
d) Travel distance : 125 m (Approx.)
e) Receiving conveyor : Belt width 1600MM with 3 rolls of equal length and troughing angle of $35^\circ$ at a speed of 3.0 m/sec

2. Duty Condition

The rotary discharge machine (RDM) will be suitable for continuous duty to reclaim coal, from self flowing bunker of 10,000 Tonnes capacity. The feeder will be installed over the slit opening running along the length of the bunker tunnel. The feeder will be capable of handling semi solid / slurry material in rainy season. The feeder will be capable of traversing continuously, and reversing direction at any point along the entire length of the reclaim slit.

The equipment will be required to operate 18 hours a day and 300 days a year, but the design will be such that it can be operated 24 hours a day and 365 days a year. The surrounding may be quite dusty and surface temperature may vary from $4^\circ$C to $50^\circ$C and relative humidity up to 100%.

3. Constructional Features

The rotary plough feeder mechanism will consist of curved arms revolving on a vertical axis to discharge the material from shelves on to a belt conveyor through a travelling chute, skirt board and adjustable dust seal etc, and will have the following specific features.:
3.1 Discharge Wheel

This will consist of six (6) radially displaced discharge arms, spaced equally round the central hub of the discharge wheel. The discharge units will be easily replaceable from the driving hub. The discharge arms will be made of wear resistant alloy steel/ equivalent steel and will be hard faced by welding.

3.2 Discharge Wheel Drive

Smooth and infinitely variable control of the discharge wheel speed will be provided by a hydraulic drive system. The prime mover will be a single speed non reversing, flame proof/explosion proof induction motor suitable for operation at 440V 50 Hz. 3 phase AC supply. Maintenance free safety facilities will be provided against overload, jammed arms, etc. Speed of the discharge wheel will be capable of remote manual control as well as manual adjustment at local panel.

3.3 Machine Travel Drive

The rotary plough feeder will traverse in either direction (forward and reverse) along the length of the bunker by means of a 440V, 50 Hz, 3ph reversible motor, fluid coupling, reduction gear units. The travel drive will be constructed as 4-wheel drive. The travel will be fully automatic and self-reversing by means of heavy-duty travel limit switches/anti-collision switches mounted on the machines.

The machine will also be capable of operating on 1% sloping travel rail. Each machine will travel for the full length of the bunker.

3.4 Main Housing

All the bearing shafts for the discharge wheel drive as well as the machine travel drive will be housed in a single totally enclosed split sealed housing of heavy duty construction. The housing will have provision for inspection and maintenance including a float switch and sight glass for protections and observations of gearbox oil level. Lifting eyes will be provided. The travel drive housing will be provided. The travel drive housing will be provided with seals against ingress of dust and moisture.

The main housing will also support the discharge chute. This will be made from 8 mm thick mild steel plate. Suitably satisfied and lined with wear resistant rubber of equivalent lining material. The discharge point will be completely dust tight.

3.5 Movable Dust Collecting System

The plough feeder will incorporate movable dust extraction system suitable for operation in slit type bunker. The movable dust collector unit will be complete with all necessary accessories like radial ventilator, bag filter, valves, motors and electrical controls, etc. Alternatively Fog type dust suppression system can also be provided.
3.6 **Lubrication**

All gear assemblies will be filled with commercial quality oil and the hydraulic system with hydraulic oil of best quality. Other parts needing lubrication will be provided with centralised lubrication system.

4.0 **Electrical Equipment**

4.1 **General**

Electrical equipment will be suitable for operation at 440 volts, 3-phase, 50 Hz.

4.3 **Motors**

The motors fitted to each plough feeder will be all suitable for operation on a 6.6kV, 3-Phase, 50 Hz, supply with variation of ±5% on voltage and ±3% on frequency.

The motors will be of flameproof construction and tested to IS 2140 and class of insulation will be ‘F’ conforming to IS 1271.

4.4 **Electrical Control System**

The electrical control system for the rotary plough feeder will include the following:

4.4.1 **Power Circuit**

This will incorporate all the necessary isolator switch, protection circuit breakers, contactors, fuses protection relays, timers, etc. housed in enclosure of dust and damp proof to IP : 35. The cubicle will be installed in a separate room at the end of the tunnel.

4.4.2 **Control Circuit**

The control circuit will provide for following machine operation.

a) Delay the start up of the travel motor until the extractor wheel has commenced to rotate.

b) Automatically stop and reverse the direction of machine travel at each end of the bunker via anti collision switches on the machine and proximity and or travel roller operation limit switches.

c) Automatic travel reversal in case of jamming of extractor wheel due to compacted material, tramp material or otherwise.

d) Manual adjustment of extractor wheel speed for various outputs ( local )

e) Reclaiming of material without machine travel.

f) Indication of various machine operating conditions like faults, machine running, etc. in the control room and local.

g) Automatic stop in case of electrical or hydraulic faults.
h) Audio/Visual alarm in the control room and of TPH of reclaim conveyor going beyond 10% of rated capacity.

i) Motor protection relay & earth leakage relay.

4.4.3 Local Control Panel (Machine Mounted)

Manual operation will be accomplished by the use of a local panel. The enclosure will have the following operational controls and other emergent conditions requiring urgent attention.

4.4.4 Push Buttons

iii) Emergency stop.

iv) Start push button for discharge wheel.

v) Reset (to reset flasher in fault advising)

vi) Discharge wheel speed adjustment (Increase - Decrease)

vii) Machine travel speed adjustment (faster -slower)

viii) Machine travel with constant speed.

4.4.5 Switches

i) Travel Drive : On/OFF

ii) Travel Drive : Left/Right

iii) Panel : Local

4.4.6 Annunciation Lamps (Local)

i) Low level of oil gearbox.

ii) Low level of oil hydraulic.

iii) High oil pressure.

iv) Hydraulic oil temperature.

v) Discharge wheel motor – Overload.


vii) Servo motor – Overload.

viii) Maintenance mode.

ix) Local mode.

x) Remote mode.

xi) Travel left.

xii) Travel right.
4.4.7 Instruments

i) Ammeter for discharge wheel drive.

ii) Speed indicator. iii) Speed selector dial.

It will also be possible to perform all the functions remotely from the coal handling plant control room.

5.0 Catenary Cable System

5.1 General

The rotary plough feeder will be supplied with a catenary cable system designed to supply for power and control to the machine and back to the control room.

5.2 Cables

The flexible copper cables of adequate size will be supplied in sufficient quantity to cater for the machine travel distance of bunker section plus maintenance bay.

5.3 Cable Trolleys

The flexible cables will be supported by means of cable trolleys of four wheels and the swivel type, designed to enable the cables to be stacked in a minimum distance.

The trolleys will be complete with cable clamps and steel wheels fitted with life sealed ball bearings.

5.4 Terminal Box

Terminal boxes will be supplied complete with terminals for catenary cable system and will be designed to receive power supply cable to rotary feeders and control cables.

6. Inspection and Quality Control

6.1 Special material

The manufacturer should furnish during inspection, without extra charge, test certificates covering mechanical properties and chemical composition for special raw materials used including that of liners. The certificates should be from the approved testing laboratories like CMERI-Dhanbad, NPL-New Delhi etc. If considered necessary, samples for such material and components may be selected as per IS : 1548 (current) by the employer's representative from amongst the raw materials and manufactured components of equipment and tested in the approved laboratory. In case samples so selected fail to meet the standard specifications, the whole lot of the manufactured components will be rejected and disqualified for use again for any CIL supplies.
6.2 **Stage Inspection**

The Employer reserves the right to carry out inspections at any stage of the process of manufacture and assembly for which all facilities will be provided by the manufacturer. Before carrying out such inspections, necessary advance information will be given to the manufacturer.

6.3 **Availability of standard specification Meters, Gauges, etc. for testing and inspection**

The manufacturer will maintain all relevant standards and codes of practices for manufacture, inspection and testing of components of the equipment ordered. He will also maintain a set of meters and gauges etc. as may be required for testing and inspection of components.

7.0 **Checks during inspection:** The details of the checks to be carried for various components are to be submitted by the contractor for Owner’s approval. However, some indicative checks on different items are given below which should necessarily form part of the quality assurance programme to be agreed with the Owner.

7.1 All plates above 20mm thickness to be ultrasonically tested for laminations. Shaft forgings and castings to be checked for hardness, microstructure and ultrasonic testing in addition to check for chemical and mechanical properties.

7.2 Following minimum NDT requirements to be ensured for welds: i) Butt welds: 10% Ultrasonic / Radiografic & 100% MPI ii) Filletwelds: 10% Magnetic particle
2.1 GENERAL INFORMATION

2.1.1 The supply and installation of electrical equipment specified herein are required for both indoor and outdoor.

2.1.2 The successful tenderer shall furnish all, but not limited to, equipment, materials and accessories and services specified herein to complete this work. The work shall have to be completed and operative in all details. Any item of work or material which may not have been specifically mentioned but incidental to or necessary for complete installations shall be provided by the Bidder without any additional charge to the purchaser.

2.1.3 The successful tenderer shall supply and/or erect the addition or modification as will be agreed upon in writing after mutual discussion.

2.1.4 The equipment to be furnished under this specification shall be packaged for shipment so as to meet the space and weight limitations to transport facilities, right up to destination.

2.1.5 Standard

2.1.5.1 The equipment and materials to be furnished under this specification shall be designed, manufactured and tested in accordance with the latest revisions of the Indian Standards (IS), British Standards (BS) and International Electro-Technical Commission (IEC) publications unless otherwise stated.

2.1.5.2 The equipment conforming to any other national standard which ensures equivalent quality are also acceptable. In such cases the tenderers shall clearly indicate the standards adopted and furnish a copy of the English Version of the Standard along with the tender.

2.1.5.3 The electrical installation shall meet the requirement of Indian Electricity Act 1910 and Indian Electricity Rules, 1956 as amended up-to-date, Mines Rules and Regulations (latest revision) and also the applicable section of the latest revision of the relevant IS code of practice.

2.1.5.4 In addition, any relevant regulations applicable to the work shall be followed. In case of any discrepancy, the decision of purchaser will be final.
Introduction:-

The project site is located in the south – western side of Jharia Coalfield and is located adjoining to Maheshpur Siding within Govindpur Area in Dhanbad District in the state of Jharkhand. The O/H line will be drawn from the main sub – station of proposed for Block - III OCP ( source - I.) The proposed Block –III OCPs is continuous and adjoining to Block IV located in the east of the proposed Block III. The above sub–station has been proposed to be located at a suitable site. The alternative source of supply i.e Source -II to be decided & identified by BCCL. The 6.6kV single circuit OHT line to be drawn from source – II to 6.6kV switching station.

TECHNICAL PARAMETERS FOR 6.6 KV O/H LINE

1. The 6600 Volt system is three-phase, 50 Hz, and is earthed through earth neutral grounding.
2. The wind pressure on pole–structures and conductors has been considered as 150 kg/sq.cm.
3. For all design calculation, the fault level at 6.6 kvbus shall be assumed as 150 MVA.
4. Construction Power :
   4.1 Power at 440 volt shall be made available for construction at one point as per convenience of the project authority. The arrangement for taking this power to other points for utilization etc. shall be the responsibility of the contractor.
   4.2 The contractor shall pay for the power consumed during construction and commissioning period at the rate prevailing in project area. The meters for this purpose shall be purchased and installed by the contractor and shall be sealed by the site Engineer.
5. A.C.S.R. ‘WOLF’ and 7/10 S/W/G. G.I. stranded wire have been considered respectively as line and continuous earth conductor for 6.6 KV lines.
6. The line conductors shall have a minimum factor of safety of 2 (two) on ultimate strength.
7. Guard wires are to be provided as per I.E.Rules (amended up to date) while crossing roads, railway line, telephone and power lines. The guard wires shall have an actual breaking strength of not less than 635 kg and shall be made of iron or steel, galvanized.
8. The various clearances and earthing system should conform to I.E.Rules (amended up to date).

9. Each pole shall be wrapped with barbed wire (of 9.38 kg /100 M) as anticlimbing device.

10. Approximately 40 (forty) / & 20 (twenty) metres length of barbed wire shall be used on each double pole structure and single pole structure respectively for wrapping at 3" spacing) of 2 (two) M length of each rail (2 M above ground) including horizontal cross members of the bracing, if any. For four pole structure approx, 100 (one hundred) metres length of barbed wire shall be used.

11. For crossing over the main mine entry, 4 (four) nos. special fabricated steel structures to be used for 6.6 KV overhead lines.

12. Minimum two nos. stay wires and one no. stay wire shall be provided in every alternate third double pole structure (and also for the double pole structure whenever there is any change in direction) and single pole structure respectively. For four pole structures minimum four nos. stay wires shall be provided. However, if there is any need for additional stay wires at any location depending on the actual site condition, the same shall be clearly brought out in the tender offer.

13. Soil Investigation:

The contractor is required to inspect and examine the route and surrounding and satisfy himself about the nature of ground and soil. Whatever data collection by the contractor before submission of the tender shall be to his entire satisfaction and no additional charges
SCOPE OF WORK

1. This is a turnkey assignment and covers complete detailed design, supply, installation and commissioning of:

1.1 Two nos 3 phase. 6.6 KV single circuit overhead line with ACSR WOLF conductor each of 4 kM length (Approx) on separate single pole structures. For each single circuit and other section of 6.6 kV OHT line is of approx. 0.5kM length with ACSR WOLF conductor on separate single pole structure.

2. All civil construction works include supply of material with the following stipulations

i) All steel and cement required for the work including rails shall be arranged by the contractor. However, essentiality certificate shall be issued by BCCL.

3. The broad classification given below is not exhaustive. As such, items not specifically mentioned in the list but required to complete the system shall be considered as included.

4. Also, if any electrical component or equipment is considered necessary and desirable as per Indian Electricity Rules (amended up to date) and read-with various circulars issued by the Director General of Mines Safety, Dhanbad or if the same is considered necessary and desirable to comply with the up-to-date engineering practices or with various codes of practices issued from time to time by Indian Standard Institution, New Delhi, the same shall be deemed to be a requirement of this tender specifications and same should subsequently be included in the offer not withstanding the fact that such requirements are not clearly or specifically indicated in this specification along with associated drawings.

5. Supply and installation of special fabricated steel structure (terminal structure) suitable for 3 (three) nos. 6.6 KV overhead conductors. The special fabricated steel structure shall have provision of fixing for each circuit Air Break Switch, Lightning Arrestor and cable End Boxes for receiving 6.6 KV Power Supply from the sources. However, the supply, installation and commissioning of only one set of Air Break Switch, Lightning Arrestor and cable End Box for each section of 6.6 KV overhead lines under consideration are within the scope of this tender.

6. Supply, installation and commissioning of two nos 6.6 KV single circuit overhead lines with ACSR WOLF conductor and continuous earth wire (GI, 7/10 SWG) at the top for each section.
single pole structures for each single circuit have been considered for the entire length of the 6.6 KV overhead lines.

Proper clearance as per IE Rules (amended upto date) should be maintained and necessary cradle guard shall be provided. In case, clearance from railway authority is needed, it shall be the responsibility of the contractor.

Two nos. stay wires for double pole structure and four nos. stay wires at each four pole structure shall be provided. Minimum 4 nos. stay wires at end structure & 1 No. for every third alternate pole for single pole structures should be provided as per IE Rules and at all road, rail, telephone line and power line crossings.

Each pole shall be wrapped with GI barbed wire as anticlimbing device.

All metal supports of overhead lines and metallic fittings attached thereto shall be permanently and efficiently earthed. For this purpose, a continuous earth wire (GI 7/10 SWG) shall be drawn along the entire length and securely fastened to each pole. The earth wire shall be connected to earth pits at least at three points, as nearly equidistant as possible, in every 1 km run. The electrodes for the earth-pits shall be GI pipes of 50 mm internal dia and 3 m. long with clean surface area. The electrodes shall be as far as practicable be embedded below permanent moisture level and shall be connected to the pole by 6 SWG GI wire. Earthing of lightning arrestors shall be done by 50 x 6 mm GI strip.

Testing and charging the lines with rated voltage.

Rectification of defects detected during the test by necessary changes in the design and/or installation procedure and/or supply of equipment, accessories and materials.

Supply of three sets of prints bound suitably of all design and installation drawings.

Handing over the installation in good working order.

**Technical Specifications**

1. Pole:

The standard section of 90 lb/yd rail for all the poles has been adopted. The single pole structures will be used for 6.6 KV overhead lines excepting at the locations for change in directions where double pole structure will be used. Four pole structure will be employed at the crossing of overhead line and railway line as well as at river bed if come across in the route.

The dimension and properties of the rail to be procured are as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Section</td>
<td>- 90 lbs/yd.</td>
</tr>
<tr>
<td>b) Moment of inertia about horizon axis</td>
<td>- 38.45 inch$^4$</td>
</tr>
<tr>
<td>c) Moment of inertia about vertical axis</td>
<td>- 7.71 inch$^4$</td>
</tr>
<tr>
<td>d) Section modulus (compression)</td>
<td>- 18.5 inch$^3$</td>
</tr>
<tr>
<td>e) Section modulus (tension)</td>
<td>- 20.9 inch$^3$</td>
</tr>
</tbody>
</table>
In case of four pole structure, for extra height of the structure, additional rail section shall be vertically joined with standard fish plate.

1. Cross arms & Cross bracings:

1.1 Three types of pole structure have been envisaged:

h) Single pole structure
i) Double pole structure
j) Four pole structure.

Single Pole structure:

Cross arms shall be or ISMC 125 (125x65) to be suitably angled to shape for fixing the insulators. For fixing the earth wire with rail pole, ISA 65x65x6 angle of suitable length (to be decided based on specified angle of 30°) is to be bolted with rail at the top.

1.2 Double pole structure:

Cross arm of ISMC 125(125x65) section of suitable length is to be provided horizontally. Cross bracings shall consist of ISA 65x65x6 angle bolted/ welded with rail pole. For fixing earthwire at the top, angles ISA 65x65x6 shall be suitably bolted so that specified angle of 30° is maintained.

For double pole structure carrying lightning arrestor, isolator and cable end box, the above configuration shall hold good except for placing isolator, three nos. of ISMC 125(125x65) shall be fixed at a suitable height below the cross arm carrying conductors. For holding cable end box, two nos. ISA 65x65x6 have provided. The connections of above channels and angles shall be of bolted connection.

1.3 Four pole structure:

Cross arm shall be of ISmC 125(125x65) section and cross bracings shall be of angles ISA 65x65x6 like other structures.

For holding the cradle guard, bracket structure (make of angle sections ISA 65x65x6) shall be provided at a specified height. For holding the earth wire ISA 65x65x6 angles shall be bolted with rail section so that 30° angle is maintained.

2. Conductors:

Aluminium conductor steel reinforced (ACSR) conductors shall comply with all the requirements of I.S. 398-1976 with latest amendments. The conductors are ACSR WOLF of 95 sq.mm. copper equivalent and having stranding and wire diameter 30/2.59 mm Al+7/2.59 mm steel.
3. Stay Set:

3.1 The correct positioning and setting of stay is essential. The angle between the pole and stay shall preferably be 45°, but where it is not possible the minimum angle of 30° must be maintained. It is important to ensure that when the stay is set, the same must have correct inclination relative to the ground and the whole screwed portion of stay rod plus 127mm shall protrude through the ground.

3.2 At the determined position the stay rod shall be bent according to correct inclination and the stay with anchor shall be embedded in C.C. foundation. The stay except the protruded portion must be plumbed and set at true vertical.

3.3 The stay set shall consist of an anchor plate of 300x300x6.5mm size and a tie rod of 19 mm dia, 1800 mm long leaving one end bolted and other end threaded to a length of 300 mm. The bow shall be fabricated from 19mm dia. Rod and riveted to the yoke plate to withstand the requisite strength. The yoke base and the nut shall be provided with ratchet groove to prevent loosening. After fabrication of the whole stay set, component shall be cleaned in a pickling bath and galvanized in hot-dipped zinc bath.

3.4 Each set shall be provided with a galvanized wire roped thimble for termination of stay wire of requisite cross-section as shown below:


2. Overall dia. ; 12.19 MM
3. Ultimate strength ; 6115 kg.

Matching galvanized thimble and insulator (loop type) are to be incorporated within the stay-set.

4. Insulator:

4.1 Porcelain insulators shall be made of high grade raw material and finished with glazing suitable for the voltage grade it is to withstand. The overall varnish shall form an impervious body to prevent corrosivity and consequent absorbing of moisture.

4.2 The 11 KV Disc & Pin type standard insulators have been selected for 6.6 KV overhead lines. The pin insulators may be provided with pin permanently sealed with if so desired.

4.3 These insulators will be used in heavily polluted atmosphere of coalfield. The insulators must comply with the relevant I.S specification in all respect.
4.4 The insulators shall confirm to the following specifications:

a. 11 KV DISC Insulator:

- Leakage distance: 280mm
- Recommended voltage grade: 11 KV
- Combined M&E strength: 8180 kg.
- Withstand test voltage (dry/wet): 75 kv/45kv
- Flashover voltage (dry/wet): 80 kv/50 kv
- Puncture voltage: 140 KV

b. 11 KV PIN Insulator:

- Creepage distance: 275 KV/45 K/v
- Recommended voltage grade: 11 KV
- Withstand test voltage (Dry/wet): 75 KV/45 KV
- Flashover voltage (Dry/WET): 80 KV/50 KV
- Puncture voltage: 140 KV

5. Earthing:

5.1 All metal supports of overhead lines and metallic fittings attached there to, shall be permanently and efficiently earthed. For this purpose a continuous earth wire shall be drawn above the conductors and securely fastened to the top of each pole and connected with earth at least three points in every one KM, the spacing between the earthing points being as nearly equidistant as possible. At earth points, the pole structure shall be securely earthed.

5.2 Each pole structure, crossing overhead line, telephone line, railway line and road, must be earthed. It is proposed to use earth wire (GI, 7/10 SWG) having breaking strength 3659.74 kg. The poles shall be connected to earth electrodes by no.6 SWG wire.

5.3 The electrodes shall be made of G.I Pipe not smaller than 50 mm internal diameter and minimum 3 metre long with clean surface area. Electrodes shall preferably be embedded below permanent moisture level.

5.4 Earth pit for earthing lightning Arrestors shall be as per IS:3043 (amended upto date). The earthing shall be done by 50x6mm GI strip.

6. 6.6 KV Lightning Arrestor:

6.1 The lightning Arrestors are required for installation on the terminal steel structure. It shall be non linear resistance thyrite valve type, conforming to IS:3070 (Part-I) amended upto date.
6.2 The arrestor shall be in a hermetically sealed porcelain housing complete with line and ground terminals.

6.3 The Arrestor shall conform to the following technical parameters:

1. Service: Outdoor
2. Class: Distribution
3. System Voltage:
   a) Nominal: 6.6 KV rms
   b) Highest: 7.2 KV rms
4. Phase: 3
5. Frequency: 50 HZ
6. System earthing: Neutral solidly earth grounding
7. Nominal discharge current: 5 KA
8. Mounting: Pedestal

6.4 The lightning Arrestors shall be tested as per the relevant Indian Standard Specification.

7. 6.6 KV off load isolator:

7.1 The 6.6 KV isolator shall be used on the terminal steel structure and shall conform to the following specifications:

i) Rated Voltage: 6.6 KV
ii) No. of phase: 3
iii) Frequency: 50 HZ
iv) Current rating: 400 Amp.
v) Short time current: 13.1 KA for 1 sec.
vii) Type: Horizontal type
     Installation: outdoor horizontally mounted
viii) Max. ambient temp.: 50°C
ix) Max. relative humidity: 99%
x) Atmosphere: Heavily polluted

7.2 Supporting Insulator:

The supporting insulator shall be of required no. of post type brown glazed porcelain insulator and tested in accordance with IS:2544-1975 (amended upto date). The phase to phase clearance shall be as per relevant standard.
The switch shall have U-type hard copper contacts and filled with hard copper blades of liberal cross section and the leakage distance shall not be less than the minimum specified in the ISS. The make and break of all the three phases shall be simultaneous. The connections shall be made with copper flexible tape.

7.3  Mounting:

The unit shall be mounted on steel channels and all mechanism shall be suitable for horizontally installations on a simple structure.

7.4  Connection Terminal:

These shall be solderless connections to accommodate standard ACSR conductor.

7.5  Operating Mechanism:

The operating mechanism shall comprise of horizontally mechanism assembly complete with gang bar of suitable cross-section and GI pipe of adequate length brought down to a handle provided with galvanised guides. The same shall have arrangement for padlocking on OFF and ON position of the switch.

7.6  The isolator shall be tested according to the latest relevant Indian Standard Specification.

8.  Cardle Guard:

8.1  Cardle guard connecting four pole structures shall be made with 4 (four) nos. 6 SWG GI wire and shall have interlacing with 6 SWG GI wire at an interval of 750 mm.

8.2  Cardle guard connecting double pole and single pole structures, shall be made with 2 (two) nos. 6 SWG GI wire and shall have interlacing with 6 SWG GI wire at an interval of 750 mm.

9.  Foundation:

For single and double pole structure PCC foundation of grade (1:2:4) has been envisaged. While for four pole structure RCC foundation of same grade must be provided. Concrete should be graded as per recommendation of IS:456 (amended upto date). The reinforcement provided in four pole foundation shall conform to IS:432 (amended upto date).
SPECIFICATION FOR 6 kV SURGE TYPE LIGHTNING ARRESTORS

1.0 SCOPE

This specification covers requirements for 6 kV Surge type Lightning Arrestors at site and suitable for outdoor application.

The 6 kV Surge type Lightning Arrestors shall comply with the latest revision of IS: 3070 except where modified or extended by the provision of this specification and with the relevant parts of standards mentioned in clause 2.0.

Any material and component not specifically stated in this specification but necessary for trouble free operation of the equipment and accessories specified herein shall deemed to be included.

2.0 OTHER RELEVANT STANDARDS

The other relevant Indian standards are as under:
IS : 4004 : Application guide for non linear resistor type surge arrestors.
IS : 5350 : Dimensions for outdoor porcelain post insulators.

Where Indian standards are not available International standards like British standards, ISO, DIN, JIS or Other standards which ensures performance equivalent or superior to Indian standard shall be followed.

The equipment covered under this specification shall comply with all the latest applicable statutory rules, regulations, acts and safety codes which may be in force during the period of execution and which are related with design, construction and operation of equipment in the locality where the equipment is to be installed.

Nothing in this specification shall be construed as to relieve the supplier of the responsibility for correctness of the design and construction of the equipment. All the standards being followed shall be listed out in the bid. Where any foreign standard is being followed, the copy of the same shall be provided with the bid.

Wherever service conditions and requirements laid down in this specification differ from applicable standards, the conditions specified herein shall prevail.

3.0 SERVICE CONDITIONS

Ambient air temperature : 5°C to 50°C.
Altitude : Maximum upto 1000 M above MSL.
Relative Humidity : Approximately 97 %.
Pollution degree : Degree 4 as per IS : 13947 (Part I) (i.e. the pollution generates persistent conductivity caused by conductive dust)

4.0 DESIGN CRITERIA

The 6 kV Surge type Lightning Arrestors shall be suitable for 6600V (-15% to +10%), 3-phase, 50 Hz (-5% to +3%) power supply. The arrestor shall be suitable for operation in a solid earthed neutral system. The arrestor shall be able to sustain power frequency spark over voltage up to 15 kV. The Lightning Arrestors shall withstand standard impulse withstand voltage of 22.5 kV. Maximum residual voltage at nominal discharge current shall be 22.5 kV.

The nominal discharge current carrying capacity has been specified in Annexure-I at the rated voltage and frequency.

5.0 CONSTRUCTIONAL FEATURES

The lightning arrestor shall be line type and gapless. The arrestors shall be composed of units of non-linear resistors made of Zinc oxide.

7.0 PERFORMANCE

Electrical Features

The lightning arrestor shall ensure:

a) Continuous operation at rated voltage (6 kV & 50 Hz) while carrying out effectively and without damage the automatic extinction of the follow up current.

b) Continuous operation within variation for voltage between -15% +10%, and frequency variation between - 5 %, + 3 % and combined voltage and frequency variation of 10%.

c) The arrestors shall divert any switching surge in excess of basic insulation level at the relevant nominal system voltage and cut off follow-up current of power frequency.

7.0 TEST CERTIFICATE

The units shall be Type tested for insulation level, discharge current and residual voltage in accordance with relevant codes. The results of the test certificate shall also indicate the identifications like manufacturer's name and the serial no. of the product which should also appear printed or embossed on the body.
The bidder shall supply at the time of execution the routine test certificates from the manufacturer indicating the type of tests conducted, the test results and the serial nos. of the lightning arrester.

**ANNEXURE - I TECHNICAL**

**PARAMETERS FOR 6 KV SURGE TYPE LIGHTNING ARRESTORS**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal System Voltage</td>
<td>- 6.6 kV</td>
</tr>
<tr>
<td>Rated Voltage</td>
<td>- 6 kV</td>
</tr>
<tr>
<td>Power frequency sparkover voltage</td>
<td>- 15 kV</td>
</tr>
<tr>
<td>1.2/50 Sparkover voltage, 2500 Amp</td>
<td>- 22.5 kV (peak)</td>
</tr>
<tr>
<td>Maximum residual voltage at nominal discharge current</td>
<td>- 22.5 kV (peak)</td>
</tr>
<tr>
<td>Nominal discharge current</td>
<td>- 10 kA</td>
</tr>
<tr>
<td>System</td>
<td>- 3 Phase, 50 C/S, Neutral solidly earthed.</td>
</tr>
<tr>
<td>Type</td>
<td>- Gapless.</td>
</tr>
<tr>
<td>Location</td>
<td>Outdoor on required structure before the HT isolator at 6.6kV switching station &amp; at proposed 2x10 MVA substation of Block-III OCP &amp; at sending and receiving end of SILO complex</td>
</tr>
<tr>
<td>Mounting</td>
<td>- Bracket mounted on structure</td>
</tr>
<tr>
<td>Other requirements</td>
<td>i) Grounding terminal</td>
</tr>
<tr>
<td></td>
<td>ii) Post insulator conforming to IS:5350.</td>
</tr>
<tr>
<td>Line terminals</td>
<td>- Each terminal should be suitable to accept ACSR and it should be suitable both for vertical take off.</td>
</tr>
<tr>
<td>Standards to conform</td>
<td>- IS : 4004 &amp; IS : 3070.</td>
</tr>
</tbody>
</table>
1.0 SCOPE

This specification covers requirements for 6.6 kV, Off Load Isolator with D.O. Fuses and Earth Switch suitable for outdoor application.

The 6.6 kV, Off Load Isolator shall comply with the latest revision of IS: 9921 except where modified or extended by the provision of this specification and with the relevant parts of standards mentioned in clause 2.0.

Any material and component not specifically stated in this specification but necessary for trouble free operation of the equipment and accessories specified herein shall deemed to be included.

2.0 OTHER RELEVANT STANDARDS

The other relevant Indian standards are as under:
IS : 3043   : Code of practices for earthing.
IS : 11353  : Guide for uniform system of marking and identification of conductors and apparatus terminals.
IS : 5350   : Dimensions for outdoor porcelain post insulators. (Part 3)
IS : 2486   : Insulator fittings for over head power lines with a nominal voltage greater than 1000 volts.
IS : 2099   : Bushings for alternating voltages above 1000 volts.

Where Indian standards are not available International standards like British standards, ISO, DIN, JIS or Other standards which ensures performance equivalent or superior to Indian standard shall be followed.

The equipment covered under this specification shall comply with all the latest applicable statutory rules, regulations, acts and safety codes which may be in force during the period of execution and which are related with design, construction and operation of equipment in the locality where the equipment is to be installed.

Nothing in this specification shall be construed as to relieve the supplier of the responsibility for correctness of the design and construction of the equipment.
All the standards being followed shall be listed out in the bid. Where any foreign standard is being followed, the copy of the same shall be provided with the bid.

Wherever service conditions and requirements laid down in this specification differ from applicable standards, the conditions specified herein shall prevail.

1.0 SERVICE CONDITIONS

- Ambient air temperature: 5°C to 50°C
- Altitude: Maximum up to 1000 M above MSL.
- Relative Humidity: Approximately 97 %.
- Pollution degree: Degree 4 as per IS : 13947 (Part I) (i.e. the pollution generates persistent conductivity caused by conductive dust)

4.0 DESIGN CRITERIA

The 6.6 kV, Off Load Isolator with D.O. Fuses and Earth Switch shall be suitable for 6600V (-15% to + 10%), 3-phase, 50 Hz (-5% to +3%) power supply. The insulators shall withstand standard impulse withstand voltage of 70 kV across the isolating distance and 60 kV to earth. One minute power frequency withstand voltage shall be 35 kV rms across the isolating distance and 27 kV to earth. The isolator shall be designed for an operating temperature of 70°C.

All similar components shall be interchangeable and shall be of same type and rating for easy maintenance and low spare inventory.

The rated current carrying capacity has been specified in Annexure-I at the rated voltage and frequency and the Isolator shall carry rated current continuously while complying with this specification. The breaking and making capacity of the Isolator shall be as specified in Annexure-I.

5.0 CONSTRUCTIONAL FEATURES

1) The isolator shall be single pole, two post single break type per phase mounted on a base of fabricated section. The contact arm shall be divided in two parts, one carrying the male contact the other carrying female contacts. The isolator shall be gang operated mounted with drop out fuse and operated manually with padlocking arrangement and Earth Switch.

2) The isolator shall be supplied with a compression type cable termination to receive 6.6kV PVCSWA cables.
3) The isolator shall be supplied with HRC type D.O. fuse of suitable rating.

4) The base of the isolator shall be suitably earthed with 25 mm x 6 mm GI strip through a earth switch of suitable rating.

5) The blades of the isolators shall be copper/hard drawn copper.

6.0 PERFORMANCE

Electrical Features

The isolator shall ensure:

a) Continuous operation at rated current at specified ambient conditions.

b) Continuous operation within variation for voltage between -15% +10% and frequency variation between -5 %, +3 % and combined voltage and frequency variation of 10%.

c) The isolator shall have to withstand apparent short circuit power of 25KA (rms) for at least 1 second.

8.0 TEST CERTIFICATE

The units shall be type tested for insulation leve, discharge current and residual voltage in accordance with relevant codes. The results of the test certificate shall also indicate the identifications like manufacturer's name and the serial no. of the production which should also appear printed embossed on the body.

The bidder shall supply at the time of execution the routine test certificates from the manufacturer indicating the type of tests conducted, the test results and the serial nos. of the lighting arrestor.
ANNEXURE - I

TECHNICAL PARAMETERS FOR 6.6 KV, OFF LOAD ISOLATOR WITH D.O. FUSES AND EARTH SWITCH

Nominal System Voltage - 6.6 kV

Highest System voltage - 7.2 kV

Rated Current - 630 A

Operation - Manual, off load, air break gang operated outdoor with earth switch

Mounting - Pole mounted

Type - Single break

No. of phases per set - Three

Contacts - Shall be high conductivity copper/copper alloy heavily tinned, leaf spring load contacts.

Reference standard - IS : 9921

Location - 6.6kV switching station, At proposed 2x10MVA substation of Block-III & at SILO complex

Accessories

i) Base channel of hot dipped galvanized iron

ii) Operating down rod with complete mechanism

iii) Operating handle, mounting base, padlock system

iv) Square rod of phase gang operation

v) H.R.C. Fuse with fuse links, 200A conforming to IS : 9385.

vi) Post insulators conforming to IS:5350.

vii) Earth Switch
SPECIFICATION FOR 6.6 KV INDOOR METAL ENCLOSED VACUUM CIRCUIT BREAKER & VACUUM CONTACTOR PANEL
(Refer Drawing NoRI-2/E&M/000031 )

1.0 SCOPE

This specification covers requirements for 6600V Metal enclosed Vacuum Circuit Breaker and vacuum contactor panels suitable for indoor application.

The circuit breaker shall comply with the latest revision of IS : 13118 except where modified or extended by the provision of this specification and with the relevant parts of standards mentioned in clause 2.0.

Any material and component not specifically stated in this specification but necessary for trouble free operation of the equipment and accessories specified herein shall deemed to be included.

2.0 OTHER RELEVANT STANDARDS

The other relevant Indian standards are as under :

- IS : 2705 : Current transformers.
- IS : 3156 : Voltage transformers.
- IS : 3043 : Code of practices for earthing.

Where Indian standards are not available International standards like British standards, ISO, DIN, JIS or Other standards which ensures performance equivalent or superior to Indian standard shall be followed.

The equipment covered under this specification shall comply with all the latest applicable statutory rules, regulations, acts and safety codes which may be in force during the period of execution and which are related with design, construction and operation of equipment in the locality where the equipment is to be installed. The equipment shall have Test Certificate for Type test from CPRI, Bangalore.

Nothing in this specification shall be construed as to relieve the supplier of the responsibility for correctness of the design and construction of the equipment.
All the standards being followed shall be listed out in the bid. Where any foreign standard is being followed, the copy of the same shall be provided with the bid. Wherever service conditions and requirements laid down in this specification differ from applicable standards, the conditions specified herein shall prevail.

3.1 **SERVICE CONDITIONS**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altitude</td>
<td>Maximum up-to 200 M above MSL.</td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>Approximately 97 %.</td>
</tr>
<tr>
<td>Pollution degree</td>
<td>Degree 4 as per IS : 13947 (Part I) (i.e. the pollution generates persistent conductivity caused by conductive dust)</td>
</tr>
</tbody>
</table>

4.0 **DESIGN CRITERIA**

The Circuit Breaker shall be suitable for 6600V (-15% to +10%), 3-phase, 50 Hz (-5% to +3%) power supply.

All similar components shall be interchangeable and shall be of same type and rating for easy maintenance and low spare inventory.

The rated current carrying capacity shall be as specified in annexure-I at the rated voltage and frequency and the circuit breaker shall carry rated current continuously while complying with this specification. The breaking and making capacity of the circuit breaker shall be as specified in annexure-I.

5.0 **CONSTRUCTIONAL DETAILS/GENERAL TECHNICAL REQUIREMENTS**

5.1 The unit shall comprise of the panel, Vacuum Circuit Breaker unit (VCB) and Vacuum Contactor Panels.

5.2 **Panel**

5.2.1 The panels shall conform to IS: 3427. The detailed specification of panel has been furnished in specification no. SP/E-04.

5.2.2 The panels shall be of unitised construction having separate compartments for the circuit breaker, vacuum contactors, bus bars, CT, PT and separate chamber for protective relays, metering and indicating instruments. The panels shall be extensible to form a multi-panel Switchboard.

5.2.3 The panels shall be fabricated from sheet steel of minimum thickness 3 mm and 2 mm for load bearing sections and non load bearing sections respectively.

5.2.4 The panels shall have a separate cable box at the rear for outgoing cables.

5.2.5 An earth bus of continuous type shall earth all metallic non-current carrying parts in the panels and the VCB and contactor units.
5.2.6 The panels shall be suitable for ready installation on embedded MS channels flushed with the floor or for direct installation on a leveled floor through grouting holes.

5.2.7 The panel shall be dust and vermin proof with no access to ingress of moisture with IP 42 protection.

5.3 **The Vacuum Circuit Breaker unit**

5.3.1 The Breaker unit shall be of horizontal DRAW OUT construction.

5.3.2 The Breaker unit shall have two main components:
   a) The trolley assembly
   b) The cradle assembly

5.3.2.1 The trolley assembly made of steel plates shall be mounted on wheels.

5.3.2.1.1 The trolley assembly shall be provided with:
   a) The pole assembly
   b) The operating mechanism

5.3.2.2 The pole assembly component of the trolley assembly shall consist of:
   a) The interrupter units having vacuum not less than 10\(^-5\) Torr.
   b) The top terminals for interrupter units, separated by fire retardant type barriers.
   c) The contacts of the breaker shall be silver plated copper or silver plated copper-chromium.

5.3.2.2.1 The operating mechanism shall consist of:
   a) Solenoid operating mechanism
   b) Control devices

5.3.2.3 The solenoid mechanism operating on the electro-magnetic principle shall close or open the interrupter. The driving force of the closing electro-magnet shall be imparted to the operating shaft with a trip free link mechanism.

5.3.2.3.1 There shall be a heavy duty plug-in type earth contact/change over switch which shall make before the insertion of trolley assembly and break after the withdrawal of the same.

5.3.3.1 The cradle assembly made of steel plates shall be mounted on chassis and shall accommodate the trolley assembly.

5.3.3.2 The cradle assembly shall consist of:
   a) Copper terminals to receive the breaker contact.
   b) Rails to guide the trolley assembly.
   c) Insulated safety shutter mechanism to make the shutter operation fully automatic depending on circuit breaker position.
5.4 **Operation of the Breaker**
The breaker shall be electrically operated locally. 
The necessary indicating devices for ON/OFF/TRIP indication and operation counter shall be provided. 
Terminal blocks for control cables shall also be provided for interfacing with other breakers if required. The closing shall be electrical.

5.5 **Duty Cycle**
The duty cycle is O - 3 min - CO - 3 min - CO.

**PERFORMANCE**

6.0 The design of the circuit breakers and accessories shall be in accordance with the latest standard practice and shall be such as to facilitate Inspection, clearing, repairs, maintenance and operation and shall ensure safety operations under situation of sudden variations of loads and voltages as may be required under local operating conditions.

6.1 **Electrical Features**
The breaker shall ensure:

a) Continuous operation at rated current at specified ambient conditions.

b) Continuous operation within variation for voltage between -15% +10%, and frequency variation between - 5 %, + 3 % and combined voltage and frequency variation of 10%.

c) Temperature rise limited to the values given in IS : 13118 for test condition.

d) The insulation levels shall conform to the values given in IS: 13118.

e) Circuit breaker shall have to withstand apparent short circuit power of 25 kA (rms) for at least 1 second.

6.3 **Mechanical Features**
a) The breaker shall be able to withstand the thermal and electromagnetic stress arising out of fault level of 25 kA for 1 seconds.

b) The trolley assembly shall have three distinct positions-SERVICE/TEST/ISOLATED WITH INDICATIONS.

c) Earthing of all metallic parts of trolley and cradle must be ensured in ISOLATED position.

7.0 **PROTECTIONS AND INTERLOCKS**

7.1 Combined IDMT type overload relay (50% to 200% of C.T. Secondary) and earth fault relay (10% to 40% of C.T. Secondary) shall be provided. High set (400% to 1600%) instantaneous element shall also be provided on at least two phases. Protective Class of C.T. with adequate ratio conforming to IS: 2705 shall be incorporated.

7.2 For incoming circuit breakers Overload IDMT overload relay, Earth Fault
IDMT relay, Neutral displacement relay, Short circuit protection shall be provided. Electrical interlock shall be provided to prevent both the incomers are ON. If one incomer is ON the other incomer will be electrically OFF. For outgoing circuit breakers Overload IDMT overload relay, Earth leakage and Short circuit protection shall be provided. For Capacitor control circuit breakers Overload IDMT overload relay, Earth Fault IDMT relay, Earth leakage and Short circuit, Over voltage unbalanced protection and Under voltage protection shall be provided.

7.3 The trip circuit shall also be operable from each of the following:
   a) Buchholz (gas operated) relay of transformer
   b) Temperature relay of transformer
   Auxiliary contacts shall be provided for the above.

7.4 Electrical interlock shall be provided to prevent ON/OFF operation with other breakers, if required. Interlocks shall be provided to ensure that the trolley can not be plugged in or out unless Vacuum Circuit Breaker is in off or open position. Vacuum Circuit Breaker shall not close unless it is fully plugged in. Interlock shall also ensure opening of the door with the breaker in isolated position only.

7.5 Protection against earth leakage shall also be provided for operation of the earth leakage relay in the range of 0.5 Amp to 2 Amp. Suitable C.B.C.T. for the same shall be provided.

7.6 Sufficient number of NO + NC auxiliary contacts shall be provided for the protections mentioned in para 7.2, 7.3 & 7.4.

8.0 METERING & MIMIC FACILITY
8.1 Following indications shall be provided:
   a) ON/OFF/TRIP
   b) Indication (Alarm/Lamp) on TRIP with reset button

8.2 Following measuring instruments shall be provided with all breakers except couplers:
   a) Voltmeter with Selector switch. 0-10 kV with measuring class P.T. on incoming breakers.
   b) Ammeter with Selector switch with measuring class C.T.
   c) P.F. meter.
   d) Frequency meter.
   e) KW meter.
   f) KWH meter. 0-99999999 Units.

8.3 Installation of Circuit Breaker unit and interfacing with other Circuit Breaker unit/Contactor panel shall be in scope of bidder. Suitable class of Current Transformer and Potential Transformer shall be provided.
9.0 **NAME PLATE**
The name plates of the circuit breaker and its operating device shall have suitable marking as under:

- Manufacturer
- Type designation and serial number
- Rated voltage
- Rated frequency
- Rated normal current
- Short circuit withstand capacity
- Rated short circuit breaking current
- Rated supply voltage of closing and opening devices
- Rated supply frequency of closing and opening devices
- Operating duty
- Supply voltage of auxiliary circuits
- Supply frequency of auxiliary circuits
- Weights
- Rated operating sequence
- Year of manufacture

10.0 **VACUUM CONTACTOR PANELS**

10.1 **CONSTRUCTIONAL DETAILS/GENERAL TECHNICAL REQUIREMENTS**
The panels shall be built in single tire construction in rigid free standing, sheet steel enclosed section. Each vertical section shall contain main bus bars, isolator, HRC fuses, contactor, CTs, PTs, etc.

The Contactor Panel shall form a complete 6600 volts switchboard.

The outgoing vacuum contactor panels will be used for control of 6600 volts motors and shall be suitable for direct on line starting. Each vertical section shall be divided into four compartments namely busbar chamber, isolator, contactors, fuse, LT control, protection and metering compartments. It shall be possible to ON-OFF the VCP from a remote control desk.

The vacuum contactor panel forming the switchboard shall conform to the following:

i) **Isolator** - Triple pole, off-load, heavy duty type isolator complete with earthing arrangement, such that when the isolator is switched off, the motor terminals are automatically earthed. The isolator shall have the following interlocks. It will not be possible to:

a) Open the door of HT chamber, unless the HT isolator is “OFF” and the earthing switch is closed and vice versa.
b) Switch On the Vacuum Contactor unless the isolator is “ON”. 
c) Open the isolator when the contactor is ON.
An automatic safety shutter shall be provided to prevent accidental contact with the live contacts when the door will open.

The isolator handle shall be lockable in ON and OFF position. A limit switch shall prevent inadvertent operation on load by switching off the contactor much before the isolator contactor open.

The OFF and Earthed position of the isolator shall be visible from the front of the panel when the panel door is closed and for this, an inspection glass window shall be provided in the front of the panel.

ii) **H.T control compartment** - A separate enclosure below the isolator compartment housing the HRC fuses, vacuum contactors, CTs and power connections shall be provided. The fuses and contactors shall be accessible from the front after opening a separate door, positively interlocked with the isolator compartment door. An insulated shutter shall be interposed between the fixed contacts and moving contacts of the HT isolator and shall be interlocked with the door opening to ensure completely safety.

iii) **L.V. compartment** - Control and indicating equipment, meters, relays etc. shall be housed in separate and completely segregated compartment along side the power module. Space for additional relays, meters etc. shall be provided at the top.

The following shall be provided in the panels:

a) 3 nos. 6.6 kV grade, vacuum contactor with surge suppressor to take care of voltage surge. 3 nos. CTs with 2 core secondary, one for metering class 1 accuracy, and the other for protection having 5P10 accuracy. The VA burden of the CTs shall suit the Relays/Metering envisaged.

b) 1 no. Space Heater with switch fuse unit

c) 3 nos. Motor duty fuses of reputed make. The fuses shall particularly have designed features suitable for motor switching duty having repetitive starting current and long acceleration time without deterioration in life.

d) 4 nos. LT control fuses

e) 1 Set Start/Stop Push Button

g) 1 no. Cable gland for XLPE cables

h) 1 set control terminals
i) 1 no. Rectifier set for vacuum contactor coil circuit j) 1 no. Ammeter with selector switch
Each vacuum contactor for motor feeder panel shall have the following relays:

j) 1 no. Motor Protection Relay for protection against thermal over currents, earth fault, phase unbalance, single phasing, stalling, overload, short circuit, earth leakage etc. ii) 1 no. Auxiliary Relay. The relays and control components shall be completely segregated from the HT components. All control connections shall be done with 2.5 mm$^2$ copper cable.

iii) Auxiliary contacts having suitable nos. of NO and NC auxiliary contacts for remote operation and indication in addition to the required for breakers own operational requirement.

**Terminals**
Porcelain HT bushing for incoming and outgoing shall be as per relevant Indian Standard.

**Metal Treatment & Painting**
The panels shall be fabricated from sheet steel of minimum thickness 3mm and 2 mm for load bearing sections and non load bearing sections respectively.

**Frame Earthing**
The earthing of the vacuum contactor panel non current carrying structure shall be provided.

**Overall Dimension**
The overall dimension shall be kept to a minimum without impairing electrical clearance and accessibility for maintenance purposes. All the leading dimensions and the general arrangement shall be furnished.
## TECHNICAL PARAMETERS OF 6.6kV INDOOR VCB & VACCUM CONTACTOR

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Installation</strong> : Indoor Panel</td>
</tr>
<tr>
<td>2</td>
<td><strong>Number of Poles</strong> : 3</td>
</tr>
<tr>
<td>3</td>
<td><strong>Service Voltage</strong> : 6600 V (-15% to 10%)</td>
</tr>
<tr>
<td>4</td>
<td><strong>Rated current (A)</strong> : As per requirement</td>
</tr>
<tr>
<td>5</td>
<td><strong>Making capacity</strong> : 62 kA (peak minimum)</td>
</tr>
<tr>
<td>6</td>
<td><strong>Frequency</strong> : 50 Hz (-5% to 3%)</td>
</tr>
<tr>
<td>7</td>
<td><strong>Symmetrical breaking capacity</strong> : 25 kA (rms minimum)</td>
</tr>
<tr>
<td>8</td>
<td><strong>Short time current for 1 Second</strong> : 25 kA (rms minimum)</td>
</tr>
<tr>
<td>9</td>
<td><strong>Operating duty</strong> : P 1</td>
</tr>
<tr>
<td>10</td>
<td><strong>Operating Mechanism</strong> : Motor operated spring charged. Trip free mechanism along-with ON/OFF/TRIP Indication.</td>
</tr>
<tr>
<td>10.1</td>
<td><strong>Manual/Electrically operated</strong> : Manual and Electrical with closing and shunt trip coil.</td>
</tr>
<tr>
<td>11</td>
<td><strong>Tripping arrangement</strong> : AC shunt trip mechanism.</td>
</tr>
<tr>
<td>12</td>
<td><strong>Meters to be provided</strong> : Ammeter with selector switches, PF meter, KWH meter, KW meter on all breakers . Additionally Voltmeter with selector switches for incomers only.</td>
</tr>
<tr>
<td>13</td>
<td><strong>Protections to be provided</strong> : i) Short circuit ii) Overload iii) Earth Fault iv) Earth leakage v) Over Voltage iv) Under voltage</td>
</tr>
<tr>
<td>14</td>
<td><strong>Indications on Control panel</strong> : ON, OFF, TRIP, LOCKOUT, CONTROL SUPPLY, SPRING CHARGED.</td>
</tr>
<tr>
<td>15</td>
<td><strong>Terminal arrangement</strong> : Conductor : Aluminium Type: PVCSWA/PVCDWA Size: Suitable size</td>
</tr>
<tr>
<td>15.1</td>
<td><strong>Incoming</strong> : Conductor : Aluminium Type: PVCSWA/PVCDWA Size: Suitable size</td>
</tr>
<tr>
<td>15.2</td>
<td><strong>Outgoing</strong> : Conductor : Aluminium Type: PVCSWA/PVCDWA Size : Suitable size</td>
</tr>
<tr>
<td>16</td>
<td><strong>Control supply</strong> : 220 V DC.</td>
</tr>
<tr>
<td>17</td>
<td><strong>Control wiring</strong> : 1.5 mm , 660 V, PVC, Copper conductor 2 2.5 mm , 660 V, PVC, Copper conductor for CTsecondary connection</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>18</td>
<td>Current Transformer</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Use of breaker as</td>
</tr>
</tbody>
</table>
SPECIFICATION FOR 6.6 kV SWITCH BOARD

1.0 SCOPE
1.1 This specification covers the requirements for 6.6 kV switch boards incorporating vacuum circuit breakers and vacuum contactors units or any combination of these.

1.2 The boards shall comply with the latest version of IS 8623 & IEC 439-1 except where modified or extended by this specification and with the relevant parts of standards mentioned in clause 2.0.

1.3 Any material, component or accessory not specifically stated in this specification but necessary for trouble free operation shall be deemed to be included.

2.0 OTHER RELEVANT STANDARDS
The other relevant standards applicable are as under:

IS : 13118     General requirements for circuit breakers for voltages above 1000V
IS : 13947     LV switch gear and control gear
IS : 10118     Code of practice for selection, installation and maintenance of switchgear and control gear
IS : 4237     General Requirements for Switchgear and Control gear for voltages not exceeding 1000 V.
IS : 6875     Switches and push-buttons
IS : 13703     LV fuses for voltages not exceeding 1000 V
IS : 12021     Specification of control transformers
IS : 3156     Voltage Transformers
IS : 11353     Guide for uniform system of marking and identification of conductors and apparatus terminals
IS : 2147     Degree of protection provided by enclosures for low voltage switchgear and Control gear
IS : 3043     Code of practice for earthing
IS : 6005     Code of practice of phosphating iron and steel.
S : 3202     Code of practice for climate proofing of electrical equipment
IS : 2629     Hot dip galvanising
IS : 5082     Wrought Aluminium and Aluminium alloys for electrical purposes
IS : 722     A C Electricity Meters
IS : 1248     Electrical Indicating instruments
IS : 3231     Electrical relays for power system protection
IS : 5       Colours for ready-mixed paints and enamels.
IS : 1554     PVC insulated cables for working voltages up to and including 1100V

Danger Notice Plates IE Rules 1956
Nothing in this specification shall be construed as to relieve the bidder of the responsibility for correctness of the design and construction of the equipment. Whenever the terms laid in this specification differ from the applicable standards, the conditions specified here in shall prevail.

Equipment complying with any other authoritative/internationally recognised standards such as IEC, BS, VDE etc. shall also be considered if it ensures performance equivalent or superior to Indian Standards. In such cases the bidder shall clearly indicate the standard adopted and furnish a copy of the latest version in English along with the bid and bring out the salient features for comparison.

The standard specifications and code of practices referred to herein shall be the latest edition including all applicable official amendments and revisions as published one month prior to the date of opening of bids. In case of conflict between this specification and those (IS Codes, Standards etc.) referred to herein, the former shall prevail.

### 3.0 SERVICE CONDITION

#### 3.1 Operating Conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Ambient air temperature</td>
<td>Maximum 50 degree centigrade</td>
</tr>
<tr>
<td>b) Altitude</td>
<td>Maximum upto 200 Meters above MSL</td>
</tr>
<tr>
<td>c) Location</td>
<td>Heavily polluted with coal dust</td>
</tr>
<tr>
<td>d) Nominal system voltage</td>
<td>6.6 kV (+10%)</td>
</tr>
<tr>
<td>e) Supply frequency</td>
<td>50 Hz (-5% to +3%)</td>
</tr>
<tr>
<td>f) System earthing</td>
<td>Effectively earthed</td>
</tr>
<tr>
<td>g) Highest fault level</td>
<td>250 MVA</td>
</tr>
</tbody>
</table>

### 4.0 DESIGN

#### 4.1 Electrical

The boards shall be designed to ensure the following:

1. Continuous operation at rated capacity at service condition mentioned before
2. Capacity to withstand fault level mentioned before
3. Capacity to withstand power frequency voltage mentioned in annexure I

#### 4.2 Mechanical

The boards shall be designed to ensure the following:

1. Ready interchangeability of components
2. Easy accessibility to components for inspection & maintenance
| 4.3 | The Bidder shall submit electrical and dimensional drawings showing complete internal details of busbars and components of each panel for purchaser's approval. |
| 5.0 | **CONSTRUCTION** |
| 5.1 | The board shall comprise single front panel / panels metal enclosed, dust & vermin proof floor mounted, free standing type. The frames and load bearing members of a panel shall be fabricated from suitable mild steel structural sections or pressed and shaped cold-rolled steel sheets of thickness not less than 2.0 mm. Frames shall be covered by cold-rolled steel sheets of thickness not less than 1.6 mm. Doors and covers shall also be of cold rolled sheets of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary. The thickness of gland plates shall not be less than 3.0 mm for hot/cold rolled steel sheets and not less than 4.0 mm for non-magnetic material. |
| 5.2 | The panel edges and cover/door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members. The top covers of the panels shall be such designed that they do not permanently bulge / bend by the weight of maintenance personnel working on it. |
| 5.3 | The complete structure shall be rigid, self-supporting, free from flaws, twists and bends. All cutouts shall be true in shape and devoid of sharp edges. |
| 5.4 | The panels shall be provided with a degree of protection IP 52. Provision shall also be made for providing IP 52 degree of protection, when a withdraw-able equipment, if any, has been withdrawn. All cutouts shall be provided with synthetic rubber gaskets. |
| 5.5 | The panels shall be of uniform height not exceeding 2100 mm |
| 5.6 | The board shall be easily extendable on both sides by the addition of panels after removing the end covers. |
| 5.7 | The panels shall be supplied with base frames made of structural steel sections along-with all necessary mounting hardware required for welding down the base frame to the foundation/steel insert plates. The base frame height shall be such that floor finishing (50 mm thick) after erection of the board does not obstruct the movement of doors, covers, withdraw-able modules etc. |
| 5.8 | A panel incorporating a breaker or an isolator or a change over
following requirements:

a) Epoxy coated busbars of required section shall be provided in all panels mounted on stable & strong supports to withstand thermal and electromagnetic forces during fault conditions.

b) Epoxy resin insulated PT & CT shall be provided in a breaker panel suitably mounted with detachable devices for withdrawal or plugging in.

c) Epoxy resin insulated control transformers shall be provided in a control power supply panel suitably mounted with detachable devices for withdrawal or plugging in.

d) Draw-out type vacuum circuit breakers of required current rating and rupturing capacity shall be provided in a breaker panel. The breaker shall be mounted on a withdraw-able truck with three positions; "SERVICE", "TEST" & "ISOLATED".

e) Fixed type vacuum contactors shall be provided in a change over panel of required load breaking capacity duly tested at a reputed test house.

f) Fixed type load break switch shall be provided in an isolator panel of required load breaking capacity duly tested at a reputed test house.

g) Fixed type auxiliary contactors shall be provided in a breaker panel for relays, inter-locks, change over contactors and remote / local operation.

h) Safety shutters with pad locking arrangement shall be provided in a breaker panel such that it automatically closes the bus spout apertures when ever the truck is withdrawn.

i) Mechanical interlocks shall be provided in a breaker panel to prevent racking of the breaker into the SERVICE position from ISOLATED/TEST position with the breaker closed or the spring charged.

j) Mechanical interlocks shall be provided in a breaker panel to prevent its withdrawal from the SERVICE position to ISOLATED/TEST position without tripping the breaker.

k) Mechanical interlocks shall be provided in a breaker panel to prevent closing of the breaker in any intermediate position.

l) Draw out handle provided in a breaker panel shall not be insurtable without tripping the breaker.

m) Definite minimum time inverse current induction over load relay, instantaneous short circuit relay and earth leakage relay with auxiliary contacts shall be provided in a breaker panel along with 220 V DC
adjustable settings between 0.5A to 2A.
In all panels suitable arrangements shall be made at each end of the earth bus for bolting to earthing conductors. The earth bus shall project out of the panel ends and shall have predrilled holes for this connection. All joint splices to earth bus shall be made through at-least two bolts and taps by proper lug and bolts connection.

n) In all panels the panel doors shall open by at least 90 degree.

o) All components in a panel shall be neatly arranged and easily accessible for operation and maintenance.

p) In all panels a galvanised steel earth bus shall be provided at the bottom welded/bolted to its framework and breaker earthing contact bar.

q) In all panels the earth bus shall have sufficient cross section to carry the short time fault current to earth, without exceeding the allowable temperature rise.

r) Draw-out handle provided in a breaker panel shall not be inser

s) In all panels all non-current carrying metal work of the panel shall be effectively bonded to the earth bus. Electrical conductivity of the whole breaker enclosure framework and truck shall be maintained even after painting.

t) In a breaker panel the truck and breaker frames shall get earthed while being inserted in the panel and positive earthing of the breaker frame shall be maintained in all positions, i.e. SERVICE & ISOLATED, as well as the throughout the intermediate travel.

u) In a breaker panel all metallic cases of relays, instruments and other panel-mounted equipments shall be connected to earth by independent stranded copper wire of size not less than 2.5 sq. mm. All the equipment mounted on the door shall be earthed through flexible wire/braids. Insulation color code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connectors, soldering is not acceptable. Looping of earth connections which would result in loss of earth connections to other devices, when a device is removed, is not acceptable. However, looping of earth connections between equipments to provide alternative paths to earth bus is acceptable.

v) In all panels the hinged doors having potential carrying equipment mounted on it shall be earthed by flexible wire/braid. For doors not having potential carrying equipment mounted on it, earth continuity
sign may also be acceptable. The Bidder shall establish earth continuity at site also.

w) In all panels the indicating and integrating meters shall be flush mounted on panel front. The instruments shall be of at least 96 mm. square size with 90 degree linear scales, and an accuracy class of 2.0 or better. The covers and cases of instruments and meters shall provide a dust and vermin proof construction.

x) In all panels the instruments shall be compensated for temperature errors and factory calibrated to directly read the primary quantities. Means shall be provided for zero adjustment without removing or dismantling the instruments.

y) In all panels the instruments shall have white dials with black numerals & lettering. Black knife edge pointer shall be provided for meters. In all panels the ammeters shall have a compressed scale at the upper current region to cover the starting current up-to 6.0 times the CT primary current.

z) In a breaker panel the push buttons shall be of spring return, push-to-actuate type. Their contacts shall be rated to make, continuously carry and break 5 A at 240 V AC. In a breaker panel the push buttons shall have one normally open and one normally closed contact unless specified otherwise. The contact faces shall be of silver alloy. In a breaker panel the push buttons shall be provided with integral escutcheon plates marked with its function. The color of the buttons shall be as under:

<table>
<thead>
<tr>
<th>Color</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>for breaker CLOSE command</td>
</tr>
<tr>
<td>Red</td>
<td>for breaker OPEN command</td>
</tr>
<tr>
<td>Black</td>
<td>for all annunciation functions, overload, reset commands</td>
</tr>
</tbody>
</table>

All push buttons in a breaker panel shall be located in such a way that Red push buttons are always to the left of Green push-buttons.

5.9 INDICATING LAMPS

a) In the breaker panels the indicating lamps of thea) panel mounting, filament type of low watt consumption shall be provided with non-hygrosopic series resistors preferably built in the lamp assembly. The lamps shall have escutcheon plates marked with its function wherever necessary.
b) The lamps shall have translucent covers of the following colors, as warranted by the application.

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>for breaker CLOSE</td>
</tr>
<tr>
<td>Green</td>
<td>for breaker OPEN</td>
</tr>
<tr>
<td>White</td>
<td>for AUTO TRIP</td>
</tr>
<tr>
<td>Blue</td>
<td>for all healthy conditions (e.g. control supply, and also for &quot;SPRING CHARGED&quot;)</td>
</tr>
<tr>
<td>Amber</td>
<td>for all Alarm Conditions (e.g. overload). Also for &quot;SERVICE&quot; and &quot;TEST&quot; position indications.</td>
</tr>
</tbody>
</table>

c) The bulbs and lamp covers shall be easily replaceable from the front of the panel. The method of mounting indicating lamp fittings on panels shall prevent their rotation under the action of lamp removal or replacements, reliance upon the tightness of ring nut for this purpose is not acceptable.

d) The indicating lamps shall be located just above the associated push-button / control switches. Red lamps shall invariably be located to the right of green lamps. In case a white lamp is also provided, it shall be placed between the red and green lamps along the centre line of control switch/push button pair. Blue and Amber should normally be located above the Red and Green lamps.

e) When associated with push-buttons, red lamps shall be directly above the green push-button and green lamp shall be directly above the red push button.

f) All indicating lamps shall be suitable for continuous operation at 90% to 110% of their rated voltage.

5.10 **INTERNAL WIRING** The board shall be supplied completely wired internally.

a) The auxiliary wiring shall be carried out with 650 V grade, single core, stranded copper conductor, color coded, and PVC insulated wires.

b) Conductor size shall be 22.5 mm (min.) for control circuit wiring and 2.5 mm (min.) for CT circuits.

c) Extra flexible wires shall be used for wiring to devices mounted on moving parts such as hinged doors. The wire bunches from the panel inside to the doors shall be properly sleeved or taped.

d) All wiring shall be properly supported, neatly arranged, readily accessible and securely connected to equipment terminals and terminal blocks.

e) All internal wiring terminations shall be made with solder less crimping type tinned copper lugs which shall firmly grip the conductor or an
provided at both ends of component to component wiring. Insulating sleeves shall be provided over the exposed parts of lugs to the extent possible.

f) Engraved core identification ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. The ferrule shall be of self locking type. The wire identification marking shall be in accordance with relevant code. Red Ferrules shall be provided on trip circuit wiring.

5.11 CONTROL TERMINAL BLOCKS

a) Control terminal blocks shall be of 650 Volts grade, rated for 10 Amps and in one piece moulding. It shall be complete with insulating barriers, clip-on type terminals and identification strips. Marking on terminal strip shall correspond to the terminal numbering on wiring diagrams. It shall have insulating material of Melamine conforming to relevant code.

b) Terminal blocks for PT & CT secondary leads shall be provided with test links and isolating facilities. CT secondary leads shall be provided with short circuit and earthing facilities.

c) In all panels at least 10% spare terminals for external connections shall be provided and these spare terminals shall be uniformly distributed on all terminal blocks.

d) The terminal blocks shall be suitable for terminating on each side two (2) nos stranded copper conductors of size up to $25 \text{ mm}^2$ each.

e) All terminals shall be numbered for identification and grouped according to the function. Engraved white-in-black labels shall be provided on the terminal blocks.

f) Wherever duplication of a terminal block is necessary it shall be achieved by solid bonding links.

g) The terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal blocks. The minimum clearance between the first row of terminal blocks and the associated cable gland plate shall be 250 mm.

5.12 NAME PLATES AND LABELS

a) The panel shall be provided with prominent, engraved identification plates.

b) The name plates shall be of non rusting metal with white non graved letterings on black back grounds. Inscriptions shall be subject to purchaser's approval.

c) Suitable stenciled paint mark shall be provided in side the panel for identification of all equipments in addition to the plastic sticker labels, if
be clearly visible. The labels shall bear the device number as indicated in the approved module wiring drawing.

Caution plate with the inscription "WARNING LIVE TERMINALS" shall be provided at all joints where the terminals are likely to remain live and isolation is possible only at remote end.

5.13 PAINTING
The sheet steel work shall be pre treated, in tanks, in accordance with relevant code. Degreasing shall be done by alkaline cleaning. Rust and scales shall be removed by pickling with acid. After pickling phosphate coating of class C in accordance with relevant code shall be provided. The phosphated surfaces shall be applied with stove lead oxide primer coating followed by two coats of finishing synthetic enamel paints. Electrostatic painting is also acceptable. Finishing paint on panels shall be shade 692 (smoke grey) in accordance with relevant code. The inner surface of the panels shall be glossy white. For electrostatic or powder painting manufacturer's standard shade for inner surface of the panels shall also be acceptable. Each coat of finishing paint shall be properly stoved. The finishing paint thickness shall not be less than 50 microns. Finished surfaces shall be coated by peel able compound by spraying method for protection against scratches, grease, dirt & oil spots. All hardware shall be nickel chromium plated or zinc passivated.

5.14 GASKETS
The gaskets wherever specified shall be of good quality synthetic rubber with good ageing, compression and oil resistant characteristic suitable for panel application.

5.15 PANEL TYPES
The panels in a board may be any of the types mentioned as under:

a) Panel Type CD (Two breaker panels for incoming supplies)

(Note: The breakers shall be housed in separate panel and each breaker shall be provided with 2 NO + 2NC contacts for interlocks such that if one breaker is ON the other breaker will be OFF)

One (1) Triple pole vacuum circuit breakers complete with all accessories and power operated mechanism
One (1) Circuit breaker control switch
Three (3) Current transformers for metering
Three (3) Current transformers for protection
One (1) Ammeter with selector switch
Three (3) Indicating lamps with resistors and colored lenses suitable for 240V AC/220V DC
Six (6) HRC Control fuses
One (1) Lock out relay
One(1) Core Balance Current Transformer (CBCT) for earth fault protection
One (1)

Single pole instantaneous earth fault relay with adjustable current setting 50% to 200% of the CBCT secondary current. The relay shall have a resetting ratio of not less than 90%.

One (1)

Suitable time delayed triple pole over current definite time delay relay with adjustable current setting 150% to 600% of the CT secondary current and adjustable time setting 0.1 Sec to 1 Sec. The relay shall have a resetting ratio of not less than 90%.

One (1)

Triple pole instantaneous short circuit protection relay with adjustable current setting 200% to 800% of the CT secondary rated current. The relay shall have a resetting ratio of not less than 90%.

Panel type AE (Panels for outgoing transformer feeders)

One (1) Triple pole vacuum circuit breakers complete with all accessories and power operated mechanism

One (1) Circuit breaker control switch

Three (3) Current transformers for metering

Three (3) Current transformers for protection

One (1) Ammeter with selector switch

Three (3) Indicating lamps with resistors and colored lenses suitable for 240V AC/220V DC

Six (6) HRC Control fuses

One (1) Lock out relay

One (1) Core Balance Current Transformer (CBCT) for earth fault protection

One (1) Single pole instantaneous earth fault relay with adjustable current setting 50% to 200% of the CBCT secondary current. The relay shall have a resetting ratio of not less than 90%.

One (1) Suitable time delayed triple pole over current definite time delay relay with adjustable current setting 150% to 600% of the CT secondary current and adjustable time setting 0.1 Sec to 1 Sec. The relay shall have a resetting ratio of not less than 90%.
rent setting 200% to 800% of the CT secondary rated current. The relay shall have a resetting ratio of not less than 90%.

(c) **Panel type LF (Panels for Lighting transformer feeders)**

One (1) Triple pole vacuum circuit breakers complete with all accessories and power operated mechanism

One (1) Circuit breaker control switch

Three (3) Current transformers for metering
Three (3) Current transformers for protection
One (1) Ammeter with selector switch
Three (3) Indicating lamps with resistors and colored lenses suitable for 240V AC/220V DC
Six (6) HRC Control fuses
One (1) Lock out relay
One(1) Core Balance Current Transformer (CBCT) for earth fault protection
One(1) Single pole instantaneous earth fault relay with adjustable current setting 50% to 200% of the CBCT secondary current. The relay shall have a resetting ratio of not less than 90%.
One (1) Suitable time delayed triple pole over current definite time delay relay with adjustable current setting 150% to 600% of the CT secondary current and adjustable time setting 0.1 Sec to 1 Sec. The relay shall have a resetting ratio of not less than 90%.
One (1) Triple pole instantaneous short circuit protection relay with adjustable current setting 200% to 800% of the CT secondary rated current. The relay shall have a resetting ratio of not less than 90%.

(d) **Panel type M (Contactor panels for outgoing motor feeders)**

One (1) Triple pole, off-load, heavy duty type isolator complete with earthing arrangement complete with all accessories and power operated mechanism

One (1) Triple pole vacuum contactor
One (1) Control switch
Three (3) Current transformers for metering
Three (3) Current transformers for protection
One(1) Core Balance Current Transformer (CBCT) for earth fault protection
One (1) Ammeter with selector switch
<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three (3)</td>
<td>Indicating lamps with resistors and colored lenses suitable for 240V AC/220V DC</td>
</tr>
<tr>
<td>Six (6)</td>
<td>HRC Control fuses</td>
</tr>
<tr>
<td>One (1)</td>
<td>Lock out relay</td>
</tr>
<tr>
<td>One (1)</td>
<td>Single pole switch and fuse of suitable rating for motor and space heater suitable for 240V AC</td>
</tr>
<tr>
<td>One (1)</td>
<td>Motor Protection Relay for protection against thermal over currents, earth fault, phase unbalance, single phasing, stalling, under voltage, overload, short circuit, earth leakage etc.</td>
</tr>
<tr>
<td>One (1)</td>
<td>Auxiliary Relay</td>
</tr>
<tr>
<td>One (1)</td>
<td>Set Auxiliary contacts having suitable nos. of NO and NC auxiliary contacts for remote operation and indication.</td>
</tr>
</tbody>
</table>

(b) **Panel type CB (Panels for control of Capacitor Bank)**

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>One (1)</td>
<td>Triple pole vacuum circuit breakers complete with all accessories and power operated mechanism</td>
</tr>
<tr>
<td>One (1)</td>
<td>Circuit breaker control switch</td>
</tr>
<tr>
<td>Three (3)</td>
<td>Current transformers for metering</td>
</tr>
<tr>
<td>Three (3)</td>
<td>Current transformers for protection</td>
</tr>
<tr>
<td>One (1)</td>
<td>Ammeter with selector switch</td>
</tr>
<tr>
<td>Three (3)</td>
<td>Indicating lamps with resistors and colored lenses suitable for 240V AC/220V DC</td>
</tr>
<tr>
<td>Six (6)</td>
<td>HRC Control fuses</td>
</tr>
<tr>
<td>One (1)</td>
<td>Lock out relay</td>
</tr>
<tr>
<td>One (1)</td>
<td>Core Balance Current Transformer (CBCT) for earth leakage protection</td>
</tr>
<tr>
<td>One (1)</td>
<td>Neutral Displacement Relay</td>
</tr>
<tr>
<td>One (1)</td>
<td>Suitable time delayed triple pole over current definite time delay relay with adjustable current setting 150% to 600% of the CT secondary current and adjustable time setting 0.1 Sec to 1 Sec. The relay shall have a resetting ratio of not less than 90%.</td>
</tr>
<tr>
<td>One (1)</td>
<td>Triple pole instantaneous short circuit protection relay with adjustable current setting 200% to 800% of the CT secondary rated current. The relay shall have a resetting ratio of not less than 90%.</td>
</tr>
</tbody>
</table>
5.16 VACUUM CIRCUIT BREAKERS
a) The breaker shall be designed to meet the requirements mentioned as under:
   - Operation at the service condition indicated in clause no 3.0
   - Capacity to withstand the fault level indicated in clause no 3.0
   - Capacity to break a minimum fault current of 20 kA
   - Capacity to make a minimum fault current of 50 kA

6.0 PERFORMANCE
a) TEMPERATURE-RISE
   The temperature rise of the bus-bars and all power draw-out contacts when carrying 90% of the rated current along the full run shall in no case exceed 55°C with silver plated joints and 40°C with all other types of joints over the specified ambient temperature. No diversity factor shall be used for temperature rise test.

b) DERATING OF EQUIPMENTS
   The Bidder shall ensure that the equipment offered carry the required load current at specified ambient temperature and perform the operating duties without exceeding the permissible temperature as per relevant code. Continuous current rating at specified ambient temperature shall in no case be less than 90% of the normal rating specified. The Bidder shall indicate clearly the derating factors, if employed for any component and furnish the basis for arriving at these derating factors duly considering the specified current ratings and ambient temperature specified.

7.0 PROTECTION CO-ORDINATION
   It shall be the responsibility of the Bidder to fully co-ordinate the overload and short circuit tripping of the incoming and outgoing circuit breakers.
9.0 QUALITY ASSURANCE PROGRAMME (QAP)

a) All materials, components and equipments covered under this specification shall be procured, manufactured, erected, commissioned and tested as per a comprehensive Quality Assurance Program (QAP) to be approved by the Purchaser. A complete quality plan shall be furnished at the time of submitting the offer.

b) The Bidder shall also furnish copies of the reference documents/plant standards acceptance norms/test and inspection procedure etc. for Purchaser's review or approval. In the approved quality plan, Purchaser shall identify customer hold points, which shall be carried out in the presence of the Purchaser's representative and beyond which work shall not proceed without the consent of Purchaser's representative in writing.

c) Purchaser reserves the right to witness any of the tests and verify the documents of the Bidder and his sub-contractor. No materials/equipments shall be dispatched from the manufacturer's works before the same is duly cleared for dispatch by the Purchaser.

d) The list of sub-vendors proposed by the Bidder for procurement of major bought out items including raw materials, semi-finished and finished components shall be subject to Purchaser's approval.

e) The Bidder shall carry out an inspection and testing program during manufacture in his works and that of his sub-vendors to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials, parts and equipments. He shall carry out all tests/inspection required to establish that the items/equipments conform to requirements of the specification and the relevant codes/standards specified in this document, in addition to tests to be carried out as per the QAP.

f) Quality audit/surveillance/approval of the results of the test and inspections shall not however, prejudice the right of the Purchaser to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Bidder in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawing etc.

10.0 TESTS AND TEST REPORTS

a) Test reports for type tests for the panels, circuit breakers, contactors, auxiliary contactors, relays, instrument transformers, indicating instruments shall be furnished along with the bid for Purchaser's approval. The type test reports shall cover all applicable tests as per relevant standards & codes.
b) The following Type Tests shall be conducted on the board and its components. For each manufacturer, one test to be conducted against supply of breaker.

i) Short time withstand test  
ii) Duty cycle test of breaker, contactor  
iii) Temperature-rise test without any diversity factors  
iv) Degree of protection test

c) The report of the Type Tests shall be issued by a reputed test house like CPRI.
## ANNEXURE I

### TECHNICAL INFORMATION

<table>
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<th>Details</th>
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<td>Applicable Standard</td>
<td>IS 8623 for panel &amp; IS 13118 for VCBs</td>
</tr>
<tr>
<td>2</td>
<td>No of panels</td>
<td>Type CD ------------------------------- Nos</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Type AE ------------------------------- Nos</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Type LF ------------------------------- Nos</td>
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<tr>
<td></td>
<td></td>
<td>Type M ------------------------------- Nos</td>
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<td>Type CB ------------------------------- Nos</td>
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<td>6</td>
<td>Rated voltage</td>
<td>6.6 kV</td>
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<tr>
<td>7</td>
<td>Rated current</td>
<td>Type CD ------------------------------- Amp</td>
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<td></td>
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<td>Type AE ------------------------------- Amp</td>
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<td>Type M ------------------------------- Amp</td>
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<tr>
<td>9</td>
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<td>TP Aluminium</td>
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<td>Bus Bar rating</td>
<td>Horizontal Main Bus 2000 A</td>
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<td>Vertical Bus 1000 A</td>
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<td>20 kA for 1 Sec</td>
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<td>Interruption capacity</td>
<td>20 kA</td>
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<td>13</td>
<td>Making capacity</td>
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</tr>
<tr>
<td>14</td>
<td>Power frequency withstand voltage</td>
<td>27 kV for 1 min for 6.6 kV</td>
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<td></td>
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<td>2 kV for 1 min for Relays , Timers , Transformers</td>
</tr>
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<td>Impulse withstand voltage</td>
<td>60 kV for 6.6 kV</td>
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<td>16</td>
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<td>O-3min-CO-3min</td>
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<td>AC 1</td>
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<td>AC control-1.5 Sq mm , 660 V PVC, Black ,Copper</td>
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<td>CT secondary-2.5 Sq mm 660V PVC, Red, Copper</td>
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<td>Earthing-1.5 Sq mm , 660 V PVC, Grey, Copper</td>
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<td>Wire indication -Self locking , PVC Ferrules</td>
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<td>22</td>
<td>Paint &amp; Finish</td>
<td>Panel outer surface- Smoke Grey</td>
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<tr>
<td></td>
<td></td>
<td>Panel inner surface -glossy White</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chassis- Zinc passivated</td>
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<tr>
<td></td>
<td></td>
<td>Command module-Aluminium anodised</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Name plate-Non rusting material</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lettering-White non graved on black back ground</td>
</tr>
</tbody>
</table>
SPECIFICATION FOR 1000kVA & 500 kVA, 6.6 kV/440 V OIL IMMERSED POWER TRANSFORMERS (Refer Drawing no RI-2/E&M/000031)

1.0 SCOPE

This specification covers requirements for two winding Power Transformers 1000 kVA & 500 kVA, 6.6/0.440 kV at site protected by primary circuit breaker and fitted with gas & oil relay, alarm, temperature indicator, tap changer and marshalling box and suitable for indoor application.

The transformers shall comply with the latest revisions of IS: 2026 and IEC: 76 except where modified or extended by the provisions of this specification and with the relevant parts of standards mentioned in para 2.0.

Any material and component not specifically stated in this specification but necessary for trouble free operation of the equipment and accessories specified herein shall deemed to be included.

2.0 OTHER RELEVANT STANDARDS

The other relevant standards applicable are as under:

- IS : 10561 : Application guide for power transformers.
- IS : 2099: Bushing for alternating voltages above 1000 V.
- IS : 3639 : Fittings and accessories for power transformers.
- IS : 335 : New insulating oil for transformers.
- IS : 3637 : Gas operated relays.
- IS : 2165 : Insulation coordination.
- IS : 2071 : Method of impulse voltage testing.
- IS : 2705 : Current transformers.
- IS : 1248 : Direct acting indicating analogue electrical measuring instruments.
- IS : 2147 : Degree of protection provided by enclosures for low voltage switchgear and control gear.
- IS : 1271 : Thermal evaluation and classification of electrical insulation.
- IS : 1554 : PVC insulated (heavy duty) electric cables - 1100V. (Part -I)
- IS : 7404 : Paper covered copper conductors
- IS : 104 : Primary paints for steel surfaces.
- IS : 2932 : Final paints for steel surfaces.
- IS : 5 : Color for ready mix paints.
Equipment complying with other internationally accepted standards like BS, VDE, JIS etc. shall also be considered if they ensure performance and constructional features equivalent or superior to standards listed before. In such a case the bidder shall clearly indicate the standards adopted, furnish a copy in English of the latest revision along-with copies of all amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.

3.0 SERVICE CONDITION
   a) Ambient Air temperature - Minimum $5^\circ$ C to Maximum $50^\circ$ C with daily average ambient air temperature of $40^\circ$ C.
   b) Altitude - Maximum up-to 1000 metres above MSL.
   c) Humidity - Relative humidity maximum up-to 100% during rainy season.
   d) Location - Indoor

4.0 RULES AND CODES.
4.1 The design and operational features of the equipment offered shall comply with the provisions of the latest version of the following acts and statutory regulations:
   a) The Indian Electricity Rules
   b) National Electricity Code

The manufacturer shall make suitable modifications, addition / alteration in the equipment whenever necessary to comply with the above mentioned rules / codes.

5.0 DESIGN FEATURES
5.1 The design of the transformers and accessories shall be in accordance with the latest standard practice and shall be such as to facilitate inspection, cleaning, repairs, maintenance and operation and shall ensure safety operations under situation of sudden variations of loads and voltages as may be required under local operating conditions.

5.2 Electrical Features
The electrical features shall ensure the following:
   a) Continuous operation at rated kVA provided service conditions does not exceed the values given in para 3.0.
   b) Continuous operation at rated kVA within $\pm 10$ percent variation (combined) of voltage and frequency.
   c) Continuous operation at rated kVA at each of the tap voltages
   d) Over loading of units as indicated in IS : 6600.
   e) Temperature rise limited to the following values:
      Cooling Oil Winding
      ON AN $45^\circ$ C $55^\circ$ C
f) The insulation levels shall be uniform and conform to the following values:

<table>
<thead>
<tr>
<th>Nominal system voltage</th>
<th>Highest system voltage</th>
<th>Rated lightning impulse withstand voltage</th>
<th>Power frequency voltage 1 minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>kV rms</td>
<td>kV rms</td>
<td>kV peak</td>
<td>kV rms</td>
</tr>
<tr>
<td>6.6</td>
<td>7.2</td>
<td>60 kV for solid earth</td>
<td>22</td>
</tr>
</tbody>
</table>

5.3 **Mechanical Features**

a) The transformer shall be able to withstand the electro-dynamic stress due to terminal short circuit of the LV side assuming the HV side fed from an infinite bus. All leads, windings in cores shall be properly supported, clamped and tightened after vacuum drying to ensure the short circuit withstand ratings. The short circuit withstand duration shall be minimum 2 sec.

b) The transformer shall be so designed as to minimise any undue noise and vibration.

6.0 **CONSTRUCTIONAL DETAILS**

6.1 **Core**

a) The transformer core shall be made of high grade non-ageing grain oriented cold rolled silicon steel sheets of low hysteresis loss and high permeability. The core structure shall be securely grounded to prevent electrostatic potential. Lifting eyes and lugs shall be provided on the limbs and coils assembly. Preferably no bolt shall be used in the cores. Clamping shall be done externally to the limb.

b) The design of the magnetic circuit shall be such as to avoid static discharges, development of short circuit paths within itself or to the earthed clamping structure and the production of flux component at right angles to the plane of lamination which may cause local heating.

c) Cores and windings shall be capable of withstanding shocks during transport, installation & service and adequate provision shall be made to prevent movement of core and winding relative to tank during these conditions.

d) All steel sections used for supporting the core shall be thoroughly sand blasted after cutting, drilling and welding.

e) The manufacturer shall furnish the exact type of core material, its BH curve, design flux density at normal tap and the source of procurement.

6.2 **TANKS**

a) Tanks shall be of welded construction and fabricated from boiler steel plates of adequate thickness. The weld procedure and performance shall be in line with ASME BPV-IX.

b) All seams and joints those are not required to be opened at site shall be factory welded and wherever possible they shall be double welded.

c) Tanks stiffeners shall be provided for general rigidity and these shall be designed to prevent retention of water.
d) The tanks shall be designed to withstand:
   i) Mechanical shocks during transportation
   ii) Vacuum filling of oil
   iii) Short circuit force

e) The transformer tank and its accessories shall be designed without pockets wherein gas may collect.

f) Adequate space shall be provided at the bottom of the tank for settlements of sediments.

g) Suitable guides shall be provided in the tank for positioning the core and coil assembly.

h) The tank shall be suitable for movement in both directions during shipment. Each tank shall be provided with
   i) Lifting lugs suitable for lifting the complete transformer
   ii) A minimum of four jacking pads.

6.3 TANK COVER
a) The tank cover shall be sloped to prevent retention of rain water and shall not distort when lifted.

b) At least two adequately sized inspection covers one at each end of the tank shall be provided for easy access to bushings and earth connection. The inspection covers shall have suitable lifting arrangement.

c) The tank covers shall be fitted with thermometer pockets (in the position of maximum oil temperature) for bulbs of oil and winding temperature indicators. The thermometer pocket shall be fitted with a captive screwed top to prevent ingress of water. It shall be possible to remove these bulbs without lowering the oil in the tank.

d) Bushings, inspection covers, thermometer pockets etc. shall be designed to prevent ingress of water into or leakage of oil from the tank.

e) All bolted connections shall be fitted with weather proof hot oil resistant neoprene gasket in between for complete oil tightness. If gasket is compressible metallic stop shall be provided to prevent over compression.

6.4 MOUNTING ARRANGEMENT
a) The transformers shall be provided with two nos. bi-directional skids and pulling eyes integral with the tank body for fixing the transformer tank on foundation.

b) These skids shall be such that the bottom of the tank is at a sufficient height above foundation for cleaning purposes. Each transformer shall be provided with uni-directional flat rollers of 1000 mm length.
6.5 **CONSERVATOR TANK**

a) The conservator tank shall have adequate capacity to accommodate oil preservation system and volumetric expansion of the total cold oil volume in the transformer and radiators for a change in temperature from minimum ambient air temperature of 5°C to 110°C.

b) The conservator shall be bolted into position so that it can be removed for cleaning purposes.

c) The conservator tank, shall be fitted with a silica-gel filter breather.

d) The conservator of all transformers below 1000 kVA shall be fitted with plain oil level gauge with two independent low level electrically insulated alarm contacts. The oil level at 30°C shall be marked on the gauge. The conservator of all transformers of 1000 kVA and above shall be provided with magnetic oil level gauge with two independent low level electrically insulated alarm and trip contacts. The oil level at 30°C shall be marked on the gauge.

6.6 **Explosion vent**

i) The transformers shall be provided with the single diaphragm type of explosion vent with air release device.

ii) An equaliser pipe shall be connected to explosion vent from the conservator.

6.7 **BUCHHOLTZ RELAY**

A double float type Buchholz relay conforming to IS : 3637 shall be provided. All gas evolved in the transformer shall be collected in this relay. The relay shall be provided with a test cock suitable for a flexible pipe connection for checking its operation. A copper tube shall be connected from the gas collector to a valve located about 1200 mm above ground level to facilitate sampling with the transformer in service. The device shall be provided with two potential free contacts, one for alarms on gas accumulation and the other for tripping on rise of pressure.

6.8 **TEMPERATURE INDICATOR**

a) **Oil Temperature indicator (OTI)**

The transformers shall be provided with a 150 mm dial type thermometer for top oil temperature indication. The thermometer shall have adjustable, potential free alarm and trip contacts, maximum reading pointer and resetting device and shall be mounted in the marshalling box (1000 kVA & above) or on tank cover (500 kVA).& bellow) A temperature sensing element suitably located in a pocket in the top oil shall be furnished. This shall be connected to the OTI by means of capacity tubing. Accuracy class of OTI shall be 2°C
or $0^\circ$ better. The OTI shall have full scale deflection of at least $240^\circ$ C and shall have linear graduation to read every $2^\circ$ C.

b) **Winding Temperature Indicator (WTI)**

A device for measuring the hot spot temperature of the winding shall be provided on all transformer 1000 kVA and above. The accuracy class of $0^\circ$ winding temperature indicator shall be $\pm 2^\circ$ C or better. It shall comprise the following:

i) Temperature sensing element

ii) Image coil and bushing current transformer

iii) Auxiliary CTs if required to match the image coil, shall be furnished and mounted in the marshalling box.

iv) 150 mm local indicating instrument with max. reading pointer mounted in marshalling box. It shall have two adjustable potential free contact, one for winding temp. high alarm and one for trip, in addition to the contacts required for control of cooling equipment.

v) Automatic ambient temp. compensation

vi) All contacts shall be adjustable on a scale and suitable for connection in 240V circuit. These shall be accessible on removal of the cover.

vii) The WTI shall have a full scale deflection of at-least $240^\circ$ C and shall have linear graduations to read every $2^\circ$ C.

### 6.9 WINDINGS

a) The conductors shall be of electrolytic grade copper free from scales and burns.

b) All windings shall be fully insulated. No graded insulation shall be accepted. Use of enamel as a sole conductor insulation is prohibited.

c) The insulation of transformer windings and connections shall be free from insulating compounds which are liable to soften, ooze out, shrink or collapse and be non-catalytic and chemically inert in transformer oil during service.

d) Coil assembly and insulating spacers shall be so arranged as to ensure free circulation of oil and to reduce the hot spot of the winding.

e) Tappings shall be so arranged as to preserve the magnetic balance of transformers at all voltage ratios.

f) The maximum fault level to which the transformers may be subjected is 500 MVA. Transformer manufacturer may take this aspect into account while designing the transformer for through fault withstand capability.

g) All bus bars and leads shall be adequately supported in insulated cleats or frames from the clamping structure.

h) The studs, set screws or bolts provided for securing cleats or frames shall be
effectively locked.

i) Bus bars and leads shall be supported throughout their length to ensure they will not move under normal service or transport or be forced from the prescribed position during any short circuit.

j) The impedance values shall be as per annexure-I

k) The winding shall be connected to achieve a vector group of DY11. In case of dual L.V. voltages, the rated capacity shall be delivered at each L.V. voltage through series parallel combination of the L.V. windings

l) The transformer shall have two winding as specified in the Annexure-I.

6.10 INSULATION MATERIALS

a) Class 'A' insulating materials specified in IS : 1271 or latest version shall be used. Wood insulation, where used, shall be well seasoned and treated.

b) Insulating Oil

i) The new insulating oil supplied with the transformer shall conform to the requirements of IS : 335. No inhibitors shall be used in the oil.

ii) Prior to filling the oil in the main tank suitable number of samples shall be tested for BDV, moisture content, resistivity at 90\(^0\) C, tan delta at 90\(^0\) C and interfacial tension. The oil samples taken from the transformer at site shall conform to the requirements of IS : 1866.

iii) The manufacturer shall dispatch the transformer filled with oil. The manufacturer shall take care of the weight limitation on transport and handling facility at site. Ten percent (10%) extra oil shall be supplied for topping up, in non returnable sealed containers suitable for outdoor storage.

6.11 EARTHING TERMINALS

Two earthing terminals suitable for connecting 50 x 8 mm mild steel flat shall be provided at positions close to the two diagonally opposite bottom corners of tank. These grounding terminals shall be suitable for bolted connection. Two earthing terminals shall also be provided on marshalling box and any other equipment mounted separately.

6.12 OIL PRESERVATION SYSTEM

The transformers shall be provided with conservator preservation system. The top of the conservator shall be filled with a silica gel filter breather. It shall be so designed that:

i) Passage of air is through dust filter and silica gel

ii) Silica gel is isolated from atmosphere by an oil seal

iii) Moisture absorption indicated by a change in color of the tinted crystal can easily observed from a distance

iv) Breather shall be mounted not less than 1400 mm above rail top level.
6.13 TERMINAL ARRANGEMENT

a) Porcelain Bushing

i) The minimum clearances in air between the phases and between the phase and earth potential of the porcelain bushings shall be in accordance with IS :2026 - part V, 1994.

ii) Bushing terminals shall be provided with suitable terminal connectors of approved type and size for ACSR/cable.

iii) All transformer bushings shall be of solid porcelain with plain sheds conforming to IS:8603.

iv) The removal of bushing shall be possible without disturbing the current transformers, secondary terminals and connectors or pipe work.

b) Cable Boxes and Disconnecting Chambers

i) Wherever cable connections are specified, suitable air insulated type cable boxes of sufficient sizes shall be provided to accommodate cable termination. Cable boxes shall be designed and installed such that it shall be possible to move away the transformer without disturbing the cable termination leaving the cable box on external supports. The support for the cable box shall be of galvanised iron.

ii) Cable boxes shall have terminal connectors of adequate size and bolt holes to receive cable lugs.

iii) The bidder shall provide earthing terminals on the cable box to suit 50 x 8 mm GI flat.

iv) All necessary cable terminating accessories such as supporting brackets, power cable lugs, hard ware, etc. shall be provided by the bidder.

v) Cable boxes shall have removable top cover and ample clearance shall be provided to enable either transformer or each cable to be subjected separately to high voltage test.

vi) Cable boxes shall have degree of protection of IP-52 as per IS : 2147.

c) Bus Duct termination

In case, bus duct termination has been indicated in Annexure-I, a flanged throat or equivalent connection shall be provided for termination of bus duct enclosure. This shall be of segregated phase type. Necessary flexible connections between the bushing terminals and bus bars shall be provided by the bidder. Pads for terminating flexible connection on the bushings shall also be provided by the bidder.
6.14 **CURRENT TRANSFORMERS**

a) Bushing CTs shall be provided. It shall be possible to remove the CTs from the transformer tank without removing the tank cover.

b) The current transformers shall comply with IS : 2705.

c) All secondary leads of bushings mounted CTs shall be brought to a terminal box near each bushing and then wired up to transformer marshalling box. The CT terminals shall have shorting facility.

6.15 **TERMINAL MARKING**

The terminal marking and their physical position shall be in accordance with IS: 2026.

6.15 **TERMINATION ARRANGEMENTS FOR NEUTRALS**

a) The transformer shall be solidly earth grounding at the secondary neutral.

b) The neutral terminal brought on to a separate neutral bushing shall be connected to associated neutral grounding pit by a copper flat in case of solid earthing.

6.17 **OFF CIRCUIT TAP CHANGE SWITCH**

a) The tap change switch shall be three phase, hand operated, for simultaneous switching of similar taps on the three phases by operating an-external handle.

b) Arrangement shall be made for securing and pad locking the tap changer in each of the working positions, and it shall not be possible for setting or padlocking in any intermediate position. An indicating device shall be provided to show tap in use.

c) The cranking device for manual operation shall be removable and suitable for operation by a man standing on ground level. The mechanism shall be complete with the following:
   i) Mechanical operation indicator.
   ii) Mechanical tap position indicator which shall be clearly visible from the transformer.
   iii) Mechanical stops to prevent over cranking of the mechanism beyond extreme tap position. iv) The manual operating mechanism shall be labeled to show the direction of operation for raising the secondary voltage and vice versa. v) A warning plate indicating "The switch shall be operated only when the transformer has been de-energized" shall be fitted.
6.18 **RADIATORS**

The radiators shall be detachable type, mounted on the tank. Each radiator shall be provided with the following:

a) A drain valve at the bottom
b) An air release plug at the top
c) Shut off valve at each point of connection to the tank. The location and configuration of radiators shall be subject to purchaser approval.

6.19 **MARSHALLING BOX**

a) A sheet steel weather, vermin and dust proof marshalling box shall be provided with each transformer of 1000 kVA and above to accommodate:

i) Temperature indicators
ii) Terminal blocks for incoming and outgoing cables

b) The sheet steel used shall be at least 2.0 mm thick. The box shall be free standing floor mounted type with a sloping roof. The degree of protection shall be IP 53 in accordance with IS : 2147.

c) The temperature indicators shall be so mounted that the dials are not more than 1600 mm from ground level.

d) The marshalling box shall have a glazed door of suitable size for convenience of temperature indicators readings.

e) All cables shall enter the kiosk from the bottom and the gland plate shall be not less than 450 mm from the base of the box. The gland plate and the associated compartment shall be sealed in suitable manner to prevent the ingress of moisture, rodents, insects etc. from the cable trench. Gland plates, cable lugs, cable glands, etc. shall be provided and installed by the bidder.

f) The marshalling box shall be supplied with space heater and cubicle lighting with ON-OFF switches and associated fuses.

g) It shall be located in such a way that, the front shall not face the transformer. It shall be mounted at-least 500 mm above the ground level.

h) The gland plate shall be made into two detachable halves, for facilitating termination of incoming and outgoing cables separately.

6.20 **PAINTING**

The internal and external surfaces including oil filed chambers and structural work to be painted shall be sand blasted to remove all rust and scale or foreign adhering matter. All steel surface in contact with insulating oil shall be painted with two coats of heat resistant, oil insoluble, insulating varnish. All steel surface exposed to weather shall be given a primary coat of zinc chromate, second coat of oil and weather resistant varnish of a color distinct from primary and last two coats of flossy oil and weather resisting non fading paint of light grey color corresponding to shade no. 631 of IS : 5. Primary paint shall be as per IS : 104 and intermediate and final coats of paint shall be as per IS : 2932.
6.21 **BOLTS AND NUTS**
All bolts and nuts exposed to weather shall be of hot dip galvanised or cadmium plate or zinc passivated steel. All bolts, nuts and washers in contact with non ferrous part which carry current shall be of phosphor bronze.

6.22 **CONTROL WIRING**
a) All controls, alarms, indicating and relaying devices provided with the transformer shall be wired by the bidder up-to the terminal blocks inside the marshalling box. The bidder shall supply and install the required 1100 V grade heavy duty PVC insulated, steel wire armoured, PVC sheathed, multicore cables with copper conductors of the least 2.5 mm conforming to IS : 1554. The cables shall be properly supported.

b) All devices and terminal blocks within the marshalling box shall be clearly identified by symbols corresponding to those used on applicable schematic or wiring diagrams.

c) Not more than two (2) wires shall be connected to one terminal. At least 20% spare terminals shall be provided. Each terminal shall be suitable for 2 connecting two numbers 2.5 mm stranded copper conductor from each side.

d) Terminal blocks for CT secondary shall have shorting facility.

6.23 **FITTINGS**
The following fittings shall be provided with all the transformers:

a) Rating and diagram plate.
b) Terminal marking plate
c) Two earthing terminals
d) Lifting lugs
e) Jacking lugs
f) Drain valve with plug of 50mm size.
g) Dehydrating breather
h) Buchholtz relay with alarm and trip contacts with one shut off valve on 50 mm conservator side for transformer 500 kVA.
i) Plain oil level indicator with minimum marking for all sizes.
j) Magnetic oil level indicator for all sizes 1000 kVA and above.
k) Thermometer pockets
l) Marshalling box for all sizes 1000 kVA and above.
m) Off load tap changing switch
n) Neutral solidly earthed grounding system.
o) Oil filling hole with cover
p) Conservator
q) Oil temperature indicator with two electrical contact for trip and alarm
r) Winding temperature indicator (WTI) with one electrical contact for trip for sizes 1000 kVA and above
s) Explosion vent with air release device
t) Skids and pulling eyes on both sides
u) Rollers. Flat unidirectional limited to 1000 mm.
v) Bushings with metal parts and gaskets.-H.V. porcelain bushing with metal parts or H.V. Cable box.
w) Filter valve.
x) Inspection cover  
y) L.V. side porcelain bushing with metal parts or cable boxes or bare bushing for bus duct.  
z) Copper flat in case of solid earthed system.  

7.0 PERFORMANCE  
a) Operating Conditions  
i) The transformers shall be capable of being loaded in accordance with IS :6600 up-to load of 150%. There shall be no limitation imposed by bushings, tap changer etc.  

ii) The transformers shall be capable of being operated continuously without danger on any tapping at the rated KVA with voltage variation of ± 10% corresponding to the voltage of the tapping.  

iii) For consideration of specific loading the transformer shall be suitable for 2 continuous operation for flux densities of 1.1 to 1.9 weber/m.  

b) Fault Conditions  
i) The transformer and all accessories including CTs shall be capable for withstanding any external short circuit at bushing terminal without damage for two (2) seconds.  

ii) The maximum flux density in any part of the cores and yoke at normal voltage$^2$ and frequency shall not exceed 1.9 wb/m.  

iii) Transformer shall accept, without injurious heating, combined voltage and frequency fluctuations which produce on over condition of 120% for one (1) minute. Bidder shall indicate 150% over voltage.  

iv) Noise level when energised at normal voltage and frequency with all auxiliary equipment running shall not exceed, when measured under standard conditions, the value specified in NEMA standard publication TR-1.  

d) Impedance  
The impedance on principal tapping shall be guaranteed to be as indicated in Annexure - I.  

8.0 INSPECTION  
The impedance on principal tapping shall be guaranteed to be as indicated in Annexure - I. The manufacturer shall carry out a comprehensive inspection and testing program during manufacture for all bought out items like the core material and also workmanship during this stage. The manufacturer shall submit the inspection program at least four weeks prior to the purchaser. The inspection shall cover but not limited to the following:
a) **Tank and Accessories**

i) Physical and dimensional check of the tank and its accessories.

ii) Weld procedure.

iii) Crack detection of welds by dye penetration test.

b) **Core**

i) Sample core material for specific loss, bend properties, magnetization characteristic and thickness.

ii) Quality of varnish used on the stampings.

iii) Inter laminar insulation between core sections before and after pressing.

iv) Assembled core material for measurement of iron loss and for any hot spot by exciting the core at the designed value of flux density.

c) **Insulating Material**

i) Physical and electrical properties of material as per relevant IS.

ii) Dielectric strength.

iii) Reaction of hot oil on insulating material.

d) **Winding**

Paper insulated winding conductor for mechanical properties and electrical properties as per relevant IS.

e) **Assembled Transformer**

Provision of all fittings and accessories on the assembled unit as per approved general arrangement drawing.

f) **Pre Shipment checks at manufacturer's works**

h) Proper packing and preservation of accessories like radiators, bushings, explosion vent, dehydrating breather, connecting pipes, conservator etc.

ii) Proper bracing to arrest the movement of the core winding assembly inside the tank.
iii) Leakage test.

11.0 Soak Pit:

Soak pit for drainage of transformer oil in case of fire is required as per IS. Accordingly in addition to conventional drainage valve a solenoid valve shall be provided.

12.0 TESTS

The manufacturer shall carry out all standard routine tests in accordance with IS : 2026 on each transformer. The manufacturer shall also carry out type tests in accordance with IS : 2026 on one piece of one rating. While the routine tests shall be carried out at manufacturer's works under prior information to purchaser, the type test certificates from reputed test houses shall be submitted for purchaser's approval giving details of each test and evaluation of test data. Tests which are common to both type and routine tests may be covered under routine test in the presence of purchaser's representative, if required. At least four (4) weeks advance notice shall be given for witnessing the tests. The sequence of testing shall be as under:

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Description of test</th>
<th>Nature of test</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Oil samples</td>
<td>Routine</td>
</tr>
<tr>
<td>2</td>
<td>Winding resistance at each/principal tap</td>
<td>Routine</td>
</tr>
<tr>
<td>3</td>
<td>Voltage ratio at each/principal tap</td>
<td>Routine</td>
</tr>
<tr>
<td>4</td>
<td>Vector group and polarity</td>
<td>Routine</td>
</tr>
<tr>
<td>5</td>
<td>No load losses and magnetising current at rated frequency and 90%, 100% and 110% of rated voltage</td>
<td>Routine</td>
</tr>
<tr>
<td>6</td>
<td>Impedance voltage and short circuit impedance at each/principal tap</td>
<td>Routine</td>
</tr>
<tr>
<td>7</td>
<td>Insulation resistance</td>
<td>Routine</td>
</tr>
<tr>
<td>8</td>
<td>Temperature rise</td>
<td>Type</td>
</tr>
<tr>
<td>9</td>
<td>Oil samples (repeat test)</td>
<td>Type</td>
</tr>
<tr>
<td>10</td>
<td>Insulation resistance (repeat test)</td>
<td>Type</td>
</tr>
<tr>
<td>11</td>
<td>Dielectric</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>i) Power frequency withstand</td>
<td>Routine</td>
</tr>
<tr>
<td></td>
<td>ii) Lightning impulse withstand</td>
<td>Routine</td>
</tr>
<tr>
<td></td>
<td>iii) Switching impulse withstand</td>
<td>Type</td>
</tr>
<tr>
<td>12</td>
<td>Oil samples (repeat test)</td>
<td>Routine</td>
</tr>
<tr>
<td>13</td>
<td>Insulation resistance (repeat test)</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Tank</td>
<td>Routine</td>
</tr>
<tr>
<td></td>
<td>i) Pressure</td>
<td>Routine</td>
</tr>
<tr>
<td></td>
<td>ii) Vacuum</td>
<td>Type</td>
</tr>
</tbody>
</table>
Six (6) sets of certified test reports and oscillograms of routine and type tests shall be submitted for evaluation prior to dispatch of equipment. The bidder shall also evaluate the test results bringing out clearly the calculations and shall correct any defect indicated by the purchaser of the tests and/or calculations.

Twelve (12) sets of bound copies of type tests and routine tests shall be submitted to purchaser for final approval for the equipment before dispatch to consignee. Routine test certificates shall bear the Serial No./ Batch No. of the equipment which shall also be embossed on the rating plate of the equipment.

**ANNEXURE - I**

**TECHNICAL PARAMETERS OF 1000 & 500 KVA TRANSFORMERS**

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rated Capacity</td>
<td>1000 kVA &amp; 500 kVA</td>
</tr>
<tr>
<td>2</td>
<td>Quantity</td>
<td>1000kVA – 2nos &amp; 500 kVA – 2nos</td>
</tr>
<tr>
<td>3</td>
<td>Location</td>
<td>At 6.6kV switching station &amp; At MCC-III</td>
</tr>
<tr>
<td>4</td>
<td>Type of transformer</td>
<td>Core type oil immersed for non parallel operation</td>
</tr>
<tr>
<td>5</td>
<td>Number of phases</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Frequency</td>
<td>50 Hz + 3%, -5%</td>
</tr>
<tr>
<td>7</td>
<td>Location</td>
<td>Indoor</td>
</tr>
<tr>
<td>8</td>
<td>Type of cooling</td>
<td>ONAN</td>
</tr>
<tr>
<td>9</td>
<td>Type of oil</td>
<td>Mineral oil</td>
</tr>
<tr>
<td>10</td>
<td>Rated capacity at the main tappings</td>
<td>Rated kVA as at sl no.1</td>
</tr>
<tr>
<td>11</td>
<td>Rated Voltage</td>
<td>6600 Volts ± 10%</td>
</tr>
<tr>
<td>12</td>
<td>HV Winding</td>
<td>440 Volts ± 10%</td>
</tr>
<tr>
<td>13</td>
<td>LV Winding</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Highest system voltage</td>
<td>7200 Volts</td>
</tr>
<tr>
<td>15</td>
<td>HV Winding</td>
<td>460 Volts</td>
</tr>
<tr>
<td>16</td>
<td>LV Winding</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Impedance voltage at rated current</td>
<td>4% ± 10% uptime 630 kVA, 5% ± 10% for 631 to 1250 kVA</td>
</tr>
<tr>
<td>18</td>
<td>Method of system earthing</td>
<td>Neutral solidly earthed</td>
</tr>
<tr>
<td>19</td>
<td>HV Winding</td>
<td>Nil</td>
</tr>
<tr>
<td>Connection symbol</td>
<td>DY11</td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>Earthing of neutral terminals</td>
<td>Required for LV windings</td>
<td></td>
</tr>
<tr>
<td>Tap changer type</td>
<td>Off circuit</td>
<td></td>
</tr>
<tr>
<td>Tappings</td>
<td>± 2.5%, ± 5%, ± 7.5%, ± 10%</td>
<td></td>
</tr>
<tr>
<td>Terminal Arrangement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) HV side</td>
<td>Cable box to suit suitable size PVCSWA(Al) cable</td>
<td></td>
</tr>
<tr>
<td>b) LV side</td>
<td>Bare bushing for flexible connection through flange mounted on tank for bus duct</td>
<td></td>
</tr>
<tr>
<td>a) Temperature rise (over Ambient) in Oil</td>
<td>45°C</td>
<td></td>
</tr>
<tr>
<td>b) Temperature rise (over Ambient) in Winding</td>
<td>55°C</td>
<td></td>
</tr>
<tr>
<td>Type of Winding</td>
<td>Double wound copper</td>
<td></td>
</tr>
<tr>
<td>Auxiliary supply voltage for alarm &amp; relay</td>
<td>240 V AC</td>
<td></td>
</tr>
<tr>
<td>Standard applicable for transformer</td>
<td>IS : 2026 (Current)</td>
<td></td>
</tr>
<tr>
<td>Standard applicable for oil used</td>
<td>IS : 335 (Current)</td>
<td></td>
</tr>
</tbody>
</table>
1.0 SCOPE

This specification covers the requirements for two winding lighting transformer protected by Vacuum Circuit Breaker and fitted with tap changer. The exact voltage ratio and kVA rating of the transformer has been specified in Annexure-I.

The transformers shall comply with the latest revisions of IS: 2026 and IEC: 76 except where modified or extended by the provisions of this specification and with the relevant parts of standards mentioned in para 2.0.

Any material and component not specifically stated in this specification but necessary for trouble free operation of the equipment and accessories specified herein shall be deemed to be included.

2.0 OTHER RELEVANT STANDARDS

The other relevant standards that are applicable are as under:
IS : 10561 : Application guide for power transformers.
IS : 1271 : Thermal evaluation and classification of electrical insulation.
IS : 1554 : PVC insulated (heavy duty) electric cables - 1100V. (Part -I)
IS : 7404 : Paper covered copper conductors
IS : 104 : Primary paints for steel surfaces.
IS : 2932 : Final paints for steel surfaces.
IS : 5 : Color for ready mix paints.

Equipment complying with other internationally accepted standards like BS, VDE, JIS etc. shall also be considered if they ensure performance and constructional features equivalent or superior to standards listed before. In such a case the bidder shall clearly indicate the standards adopted, furnish a copy in English of the latest revision along-with copies of all amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.
3.0 **SERVICE CONDITION**

a) Ambient Air temperature - Minimum 5°C to Maximum 50°C with daily average ambient air temperature of 40°C.

b) Altitude - Maximum up-to 200 metres above MSL.

c) Humidity - Relative humidity maximum up-to 100% during rainy season.

d) Location - Indoor or outdoor as indicated elsewhere.

4.0 **RULES AND CODES**

The design and operational features of the equipment offered shall comply with the provisions of the latest version of the following rules and codes.

a) The Indian Electricity Rules

b) National Electricity Code

The manufacturer shall make suitable modifications, addition/alteration in the equipment whenever necessary to comply with the above mentioned Rules / Codes.

5.0 **DESIGN FEATURES**

5.1 The design of the transformers and accessories shall be in accordance with the latest standard practice and shall be such as to facilitate inspection, cleaning, repairs, maintenance and operation and shall ensure safety operations under situation of sudden variations of loads and voltages as may be required under local operating conditions.

5.2 **Electrical Features**

The electrical features shall ensure the following:

a) Continuous operation at rated kVA provided service conditions does not exceed the values given in para 3.0.

b) Continuous operation at rated kVA within ± 10 percent variation (combined) of voltage and frequency.

c) Continuous operation at rated kVA at each of the tap voltages

d) Over loading of units as indicated in IS : 6600

e) Temperature rise limited to the following values:

<table>
<thead>
<tr>
<th>Cooling Oil</th>
<th>Winding</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON AN</td>
<td>45°C</td>
</tr>
</tbody>
</table>

f) The insulation levels shall be uniform and conform to the following values:

<table>
<thead>
<tr>
<th>Nominal system voltage (kV rms)</th>
<th>Highest system voltage (kV rms)</th>
<th>Rated lightning impulse withstand voltage (kV peak)</th>
<th>Power frequency voltage 1 minute (kV rms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.6</td>
<td>7.2</td>
<td>40</td>
<td>20</td>
</tr>
</tbody>
</table>
5.3 Mechanical Features

a) The transformer shall be able to withstand the electro-dynamic stress due to terminal short circuit of the LV side assuming the HV side fed from an infinite bus. All leads, windings in cores shall be properly supported, clamped and tightened after vacuum drying to ensure the short circuit withstand ratings. The short circuit withstand duration shall be minimum 2 sec.

b) The transformer shall be so designed as to minimise any undue noise and vibration.

6.0 CONSTRUCTIONAL DETAILS

6.1 Core

a) The transformer core shall be made of high grade non-ageing grain oriented cold rolled silicon steel sheets of low hysterisis loss and high permeability. The core structure shall be securely grounded to prevent electrostatic potential. Lifting eyes and lugs shall be provided on the limbs and coils assembly. Preferably no bolt shall be used in the cores. Clamping shall be done externally to the limb.

b) The design of the magnetic circuit shall be such as to avoid static discharges, development of short circuit paths within itself or to the earthed clamping structure and the production of flux component at right angles to the plane of lamination which may cause local heating.

c) Cores and windings shall be capable of withstanding shocks during transport, installation & service and adequate provision shall be made to prevent movement of core and winding relative to tank during these conditions.

d) All steel sections used for supporting the core shall be thoroughly sand blasted after cutting, drilling and welding.

e) The manufacturer shall furnish the exact type of core material, its BH curve, design flux density at normal tap and the source of procurement.

6.2 Tanks

a) Tanks shall be of welded construction and fabricated from boiler steel plates of adequate thickness. The weld procedure and performance shall be in line with ASME BPV-IX.

b) All seams and joints those are not required to be opened at site shall be factory welded and wherever possible they shall be double welded.

c) Tanks stiffeners shall be provided for general rigidity and these shall be designed to prevent retention of water.

d) The tanks shall be designed to withstand:
   i) Mechanical shocks during transportation
   ii) Vacuum filling of oil
   iii) Short circuit force

e) The transformer tank and its accessories shall be designed without pockets wherein gas may collect.
f) Adequate space shall be provided at the bottom of the tank for settlements of sediments.

g) Suitable guides shall be provided in the tank for positioning the core and coil assembly.

h) The tank shall be suitable for movement in both directions during shipment. Each tank shall be provided with:
   i) Lifting lugs suitable for lifting the complete transformer
   ii) A minimum of four jacking pads to be raised or lowered using hydraulic or screw jacks.

6.3 TANK COVER

a) The tank cover shall be sloped to prevent retention of rain water and shall not distort when lifted.

b) At least two adequately sized inspection covers one at each end of the tank shall be provided for easy access to bushings and earth connection. The inspection covers shall have suitable lifting arrangement.

c) Bushings, inspection covers etc. shall be designed to prevent ingress of water into or leakage of oil from the tank.

d) All bolted connections shall be fitted with weather proof hot oil resistant neoprene gasket in between for complete oil tightness. If gasket is compressible metallic stop shall be provided to prevent over compression.

6.4 MOUNTING ARRANGEMENT

a) The transformers shall be provided with two nos. bi-directional skids and pulling eyes integral with the tank body for fixing the transformer tank on foundation.

b) These skids shall be such that the bottom of the tank is at a sufficient height above foundation for cleaning purposes. Each transformer shall be provided with uni-directional, flat rollers of 1000 mm length.

6.5 CONSERVATOR TANK

a) The conservator tank shall have adequate capacity to accommodate oil preservation system and volumetric expansion of the total cold oil volume in the transformer and radiators for a change in temperature from minimum ambient air temperature of 5°C to 11°C.

b) The conservator shall be bolted into position so that it can be removed for cleaning purposes.

c) The conservator tank, shall be fitted with a silica gel filter breather.

d) The conservator shall be fitted with plain oil level gauge. The oil level at 30°C
shall be marked on the gauge.

6.6 **Explosion vent**

i) The transformers shall be provided with the single type of explosion vent.

ii) An equaliser pipe shall be connected to explosion vent from the conservator.

6.7 **WINDINGS**

a) The conductors shall be of electrolytic grade copper free from scales and burns.

b) All windings shall be fully insulated. No graded insulation shall be accepted. Use of enamel as a sole conductor insulation is prohibited.

c) The insulation of transformer windings and connections shall be free from insulating compounds which are liable to soften, ooze out, shrink or collapse and be non-catalytic and chemically inert in transformer oil during service.

d) Coil assembly and insulating spacers shall be so arranged as to ensure free circulation of oil and to reduce the hot spot of the winding.

e) Tappings shall be so arranged as to preserve the magnetic balance of transformers at all voltage ratios.

f) The fault level to which the transformers may be subjected are as under:

<table>
<thead>
<tr>
<th>Nominal System Voltage (kV rms)</th>
<th>Maximum Fault Level (MVA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.6</td>
<td>500</td>
</tr>
</tbody>
</table>

Transformer manufacturer may take this aspect into account while designing the transformer for the through fault withstand capability.

g) All bus bars and leads shall be adequately supported in insulated cleats or frames from the clamping structure.

h) The studs, set screws or bolts provided for securing cleats or frames shall be effectively locked.

i) Bus bars and leads shall be supported throughout their length to ensure they will not move under normal service or transport or be forced from the prescribed position during any short circuit.

j) The impedance values shall be 4 % ± 10 %.

k) The winding shall be connected to achieve a vector group of DY11. In case of dual H.V. voltages, the rated capacity shall be delivered at each H.V. voltage through series parallel combination of the H.V. windings

l) The transformer shall have two or three winding as specified in the Annexure-I
6.8 **INSULATION MATERIALS**

a) Class 'A' insulating materials specified in IS : 1271 or latest version shall be used. Wood insulation, where used, shall be well seasoned and treated.

b) Insulating Oil
i) The new insulating oil supplied with the transformer shall conform to the requirements of IS : 335 tested at bidder's premises. No inhibitors shall be used in the oil.

ii) Prior to filling the oil in the main tank suitable number of samples shall be tested for BDV, moisture content, resistivity at 90 deg C, tan delta at 90 deg C and interfacial tension. The oil samples taken from the transformer at site shall conform to the requirements of IS : 1866.

iii) The manufacturer shall dispatch the transformer filled with oil. The manufacturer shall take care of the weight limitation on transport and handling facility at site. Ten percent (10%) extra oil shall be supplied for topping up, in non returnable sealed containers suitable for outdoor storage.

6.9 **EARTHING TERMINALS**

Two earthing terminals suitable for connecting 50 x 8 mm mild steel flat shall be provided at positions close to the two diagonally opposite bottom corners of tank. These grounding terminals shall be suitable for bolted connection.

6.10 **OIL PRESERVATION SYSTEM**

The transformers shall be provided with the conventional conservator preservation system with a single compartment with dry air filling of space above the oil. The top of the conservator shall be connected to the atmosphere through a silica gel filter breather. It shall be so designed that:

i) Passage of air is through dust filter and silica gel

ii) Moisture absorption indicated by a change in color of the tinted crystal can easily observed from a distance

iii) Breather shall be mounted not less than 1400 mm above rail top level.

6.11 **TERMINAL ARRANGEMENT**

a) **Porcelain Bushing**

i) The minimum clearances in air between the phases and between the phase and earth potential of the porcelain bushings shall be in accordance with IS : 2026 - part V, 1994.

ii) Bushing terminals shall be provided with suitable terminal connectors of approved type and size for ACSR as specified in the annexure.
iii) All transformer bushings shall be of solid porcelain with plain sheds conforming to IS:8603.

iv) The removal of bushing shall be possible without disturbing the current transformers, secondary terminals and connectors or pipe work.

b) **Cable Boxes and Disconnecting Chambers**
   
i) Wherever cable connections are specified, suitable air insulated type cable boxes of sufficient sizes shall be provided to accommodate cable termination. Cable boxes shall be designed and installed such that it shall be possible to move away the transformer without disturbing the cable termination leaving the cable box on external supports. The support for the cable box shall be of galvanised iron.

   ii) Cable boxes shall have terminal connectors of adequate size and bolt holes to receive cable lugs.

   iii) The bidder shall provide earthing terminals on the cable box to suit 50 x 8 mm GI flat.

   iv) All necessary cable terminating accessories such as supporting brackets, power cable lugs, hard ware etc. shall be provided by the bidder.

   v) Cable boxes shall have removable top cover and ample clearance shall be provided to enable either transformer or each cable to be subjected separately to high voltage test.

   vi) Cable boxes shall have degree of protection of IP-52 as per IS : 2147.

6.12 **TERMINAL MARKING**

The terminal marking and their physical position shall be in accordance with IS: 2026.

6.13 **TERMINATION ARRANGEMENT FOR NEUTRAL**

a) The transformer shall be solidly earthed at the secondary neutral.

b) The neutral terminal brought on to a separate neutral bushing shall be connected to associated neutral grounding pit by a copper flat, which shall be supplied and installed by the bidder.

6.14 **OFF CIRCUIT TAP CHANGE SWITCH**

a) The tap change switch shall be three phase, hand operated, for simultaneous switching of similar taps on the three phases by operating an-external handle.
b) Arrangement shall be made for securing and pad locking the tap changer in each of the working positions, and it shall not be possible for setting or padlocking in any intermediate position. An indicating device shall be provided to show tap in use.

c) The cranking device for manual operation shall be removable and suitable for operation by a man standing on ground level. The mechanism shall be complete with the following:

i) Mechanical operation indicator.

ii) Mechanical tap position indicator which shall be clearly visible from the transformer.

iii) Mechanical stops to prevent over cranking of the mechanism beyond extreme tap position.

iv) The manual operating mechanism shall be labeled to show the direction of operation for raising the secondary voltage and vice versa.

v) A warning plate indicating "The switch shall be operated only when the transformer has been de-energised" shall be fitted.

6.15 **cooling tubes**

The tubes shall be mounted on the tank.

6.16 **PAINTING**

The internal and external surfaces including oil filled chambers and structural work to be painted shall be sand blasted to remove all rust and scale or foreign adhering matter. All steel surfaces in contact with insulating oil shall be painted with two coats of heat resistant, oil insoluble, insulating varnish. All steel surface exposed to weather shall be given a primary coat of zinc chromate, second coat of oil and weather resistant varnish of a color distinct from primary and last two coats of flossy oil and weather resisting non fading paint of light grey color corresponding to shade no. 631 of IS : 5. Primary paint shall be as per IS : 104 and intermediate and final coats of paint shall be as per IS : 2932.

6.17 **BOLTS AND NUTS**

All bolts and nuts exposed to weather shall be of hot dip galvanised or cadmium plate or zinc passivated steel. All bolts, nuts and washers in contact with non ferrous part which carry current shall be of phosphor bronze.

6.18 **FITTINGS**

The following fittings shall be provided with all the transformers:

a) Rating and diagram plate.
b) Terminal marking plate
c) Two earthing terminals
d) Lifting lugs
e) Jacking lugs
f) Drain valve with plug, 50mm size.
g) Dehydrating breather
h) Plain oil level indicator with minimum marking.
i) Off load tap changing switch
j) Oil filling hole with cover
k) Conservator
l) Explosion vent
m) Skids and pulling eyes on both sides
n) Rollers, Flat unidirectional limited to 1000 mm
o) H.V. porcelain bushings with metal parts or H.V. cable box.
p) Filter valve.
q) Inspection cover
r) L.V. cable box.

7.0 PERFORMANCE

a) Operating Conditions
i) The transformers shall be capable of being loaded in accordance with IS :6600 up-to load of 150%. There shall be no limitation imposed by bushings, tap changer etc.

ii) The transformers shall be capable of being operated continuously without danger on any tapping at the rated KVA with voltage variation of ± 10% corresponding to the voltage of the taping.

iii) For consideration of specific loading the transformer shall be suitable for 2 continuous operation for flux densities of 1.1 to 1.9 weber/m.

b) Fault Conditions

i) The transformer and all accessories shall be capable for withstanding any external short circuit at bushing terminal without damage for two (2) seconds.

ii) The maximum flux density in any part of the cores and yoke at normal voltage and frequency shall not exceed 1.9 wb/m.

iii) Manufacturer shall also indicate 150 % over voltage withstand time.

c) Impedance

The impedance on principal tapping shall be guaranteed to be as indicated in Annexure - I

8.0 INSPECTION

The manufacturer shall carry out a comprehensive inspection and testing program during manufacture for all bought out items like the core material and also workmanship during this stage. The manufacturer shall submit the
inspection program at least four weeks prior to the purchaser. The inspection shall cover but not limited to the following:

a) **Tank and Accessories**

   i) Physical and dimensional check of the tank and its accessories.
   
   ii) Weld procedure.
   
   iii) Crack detection of welds by dye penetration test.

b) **Core**

   i) Sample core material for specific loss, bend properties, magnetization characteristic and thickness.
   
   ii) Quality of varnish used on the stampings.
   
   iii) Inter laminar insulation between core sections before and after pressing.
   
   iv) Assembled core material for measurement of iron loss and for any hot spot by exciting the core at the designed value of flux density.

c) **Insulating Material**

   i) Physical and electrical properties of material as per relevant IS.
   
   ii) Dielectric strength.
   
   iii) Reaction of hot oil on insulating material.

d) **Winding**

   Paper insulated winding conductor for mechanical properties and electrical properties as per relevant IS.

e) **Assembled Transformer**

   Provision of all fittings and accessories on the assembled unit as per approved general arrangement drawing

f) **Pre Shipment checks at manufacturer’s works**

   h) Proper packing and preservation of accessories like radiators, bushings, explosion vent, dehydrating breather, connecting pipes, conservator etc.

   ii) Proper bracing to arrest the movement of the core winding assembly inside the tank.

   iii) Leakage test.
9.0 **TESTS**

The manufacturer shall carry out all standard routine tests in accordance with IS : 2026 on each transformer. The manufacturer shall also carry out type tests in accordance with IS : 2026 on one piece of one rating.

While the routine tests shall be carried out at manufacturer's works under prior information to purchaser, the type test certificates from reputed test houses shall be submitted for purchaser's approval giving details of each test and evaluation of test data.

Tests which are common to both type and routine tests may be covered under routine test in the presence of purchaser's representative, if required.

At least four (4) weeks advance notice shall be given for witnessing the tests. The sequence of testing shall be as under:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description of test</th>
<th>Nature of test</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Oil samples</td>
<td>Routine</td>
</tr>
<tr>
<td>2</td>
<td>Winding resistance at each/principal tap</td>
<td>Routine</td>
</tr>
<tr>
<td>3</td>
<td>Voltage ratio at each/principal tap</td>
<td>Routine</td>
</tr>
<tr>
<td>4</td>
<td>Vector group and polarity</td>
<td>Routine</td>
</tr>
<tr>
<td>5</td>
<td>No load losses and magnetising current at rated frequency and 90%, 100% and 110% of rated voltage</td>
<td>Routine</td>
</tr>
<tr>
<td>6</td>
<td>Impedance voltage and short circuit impedance at each/principal tap</td>
<td>Routine</td>
</tr>
<tr>
<td>7</td>
<td>Insulation resistance</td>
<td>Routine</td>
</tr>
<tr>
<td>8</td>
<td>Temperature rise</td>
<td>Type</td>
</tr>
<tr>
<td>9</td>
<td>Oil samples (repeat test)</td>
<td>Type</td>
</tr>
<tr>
<td>10</td>
<td>Insulation resistance (repeat test)</td>
<td>Type</td>
</tr>
<tr>
<td>11</td>
<td>Dielectric</td>
<td>Routine</td>
</tr>
<tr>
<td></td>
<td>i) Power frequency</td>
<td>Routine</td>
</tr>
<tr>
<td></td>
<td>ii) Lightning impulse</td>
<td>Routine</td>
</tr>
<tr>
<td></td>
<td>iii) Impulse withstand</td>
<td>Type</td>
</tr>
<tr>
<td>12</td>
<td>Oil samples (repeat test)</td>
<td>Routine</td>
</tr>
<tr>
<td>13</td>
<td>Insulation resistance (repeat test)</td>
<td>Routine</td>
</tr>
<tr>
<td>14</td>
<td>Tank</td>
<td>Routine</td>
</tr>
<tr>
<td></td>
<td>i) Pressure</td>
<td>Routine</td>
</tr>
<tr>
<td></td>
<td>ii) Vacuum</td>
<td>Routine</td>
</tr>
<tr>
<td></td>
<td>iii) Leakage</td>
<td>Type</td>
</tr>
</tbody>
</table>
Six (6) sets of certified test reports and oscillograms of routine and type tests shall be submitted for evaluation prior to dispatch of equipment. The bidder shall also evaluate the test results bringing out clearly the calculations and shall correct any defect indicated by the purchaser of the tests and/or calculations.

Twelve (12) sets of bound copies of type tests and routine tests shall be submitted to purchaser for final approval for the equipment before dispatch to consignee. Routine test certificates shall bear the Serial No./Batch No. of the equipment which shall also be embossed on the rating plate of the equipment.
<table>
<thead>
<tr>
<th>No.</th>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rated Capacity</td>
<td>200 kVA</td>
</tr>
<tr>
<td>2</td>
<td>Quantity</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>3</td>
<td>Location</td>
<td>6.6kV switching station &amp; SILO room</td>
</tr>
<tr>
<td>4</td>
<td>Type of transformer</td>
<td>Core type oil immersed</td>
</tr>
<tr>
<td>5</td>
<td>Number of phases</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Frequency</td>
<td>50 Hz + 3%, -5%</td>
</tr>
<tr>
<td>7</td>
<td>Location</td>
<td>Indoor</td>
</tr>
<tr>
<td>8</td>
<td>Type of cooling</td>
<td>ONAN</td>
</tr>
<tr>
<td>9</td>
<td>Type of oil</td>
<td>Mineral oil</td>
</tr>
<tr>
<td>10</td>
<td>Rated capacity at the main tappings</td>
<td>Rated kVA as at sl no.1</td>
</tr>
<tr>
<td>11</td>
<td>Rated Voltage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HV Winding</td>
<td>6600 Volts ± 10%</td>
</tr>
<tr>
<td></td>
<td>LV Winding</td>
<td>230 Volts (L-L) ± 10%</td>
</tr>
<tr>
<td>12</td>
<td>Highest system voltage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HV Winding</td>
<td>7200 Volts</td>
</tr>
<tr>
<td></td>
<td>LV Winding</td>
<td>250 Volts</td>
</tr>
<tr>
<td>13</td>
<td>Impedance voltage at rated current</td>
<td>4% ± 10%</td>
</tr>
<tr>
<td>14</td>
<td>Method of system earthing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HV Winding</td>
<td>Nil</td>
</tr>
<tr>
<td></td>
<td>LV Winding</td>
<td>Star -Solid</td>
</tr>
<tr>
<td>15</td>
<td>Rated Insulation level</td>
<td></td>
</tr>
<tr>
<td>15.1</td>
<td>One minute power frequency withstand</td>
<td>20 kV rms for 6.6 kV voltage</td>
</tr>
<tr>
<td>15.2</td>
<td>Switching impulse withstand test</td>
<td>40 kV peak for 6.6kV voltage with standard full wave for windings for 1/50 microseconds.</td>
</tr>
<tr>
<td>15.3</td>
<td>Lightning withstand test voltage</td>
<td>40 kV peak for 6.6 kV standard full wave for winding for 1.2/50 microseconds.</td>
</tr>
<tr>
<td>16</td>
<td>Connection symbol</td>
<td>DYn11</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>17</td>
<td>Earthing of neutral terminals</td>
<td>: Required for LV winding</td>
</tr>
<tr>
<td>18</td>
<td>Tap changer type</td>
<td>: Off circuit</td>
</tr>
<tr>
<td>19</td>
<td>Tapping percentages</td>
<td>: + 2.5, + 5 * 5 steps/ + 5 + 7.5 * 5 steps</td>
</tr>
<tr>
<td>20</td>
<td>Terminal Arrangement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) HV side</td>
<td>: Cable box</td>
</tr>
<tr>
<td></td>
<td>b) LV side</td>
<td>: Cable box</td>
</tr>
<tr>
<td>21</td>
<td>a) Temperature rise (over Ambient) in Oil</td>
<td>45°C</td>
</tr>
<tr>
<td></td>
<td>b) Temperature rise (over Ambient) in Winding</td>
<td>55°C</td>
</tr>
<tr>
<td>22</td>
<td>Type of Winding</td>
<td>Double wound Copper</td>
</tr>
<tr>
<td>23</td>
<td>Standard applicable for transformer</td>
<td>: IS : 2026 (Current)</td>
</tr>
<tr>
<td>24</td>
<td>Standard applicable for oil used</td>
<td>: IS : 335 (Current)</td>
</tr>
</tbody>
</table>
SPECIFICATION FOR MOTOR CONTROL CENTRES AND DISTRIBUTION BOARDS (Refer Drawing No RI/-E&M/000031)

1.0 SCOPE

1.1 This specification covers requirements for 440 V Switch Boards/Motor Control Centres (MCC) incorporating circuit breakers or fuse switch units or any combination of these.

1.2 The Boards/MCC shall comply with the latest version of IS 8623 & IEC 439-1 except where modified or extended by this specification and with the relevant parts of standards mentioned in clause 2.0.

1.3 Any material and component not specifically stated in this specification but necessary for trouble free operation of the motor and its accessories specified herein shall be deemed to be included.

2.0 OTHER RELEVANT STANDARDS

2.1 The other relevant standards applicable are as under:

<table>
<thead>
<tr>
<th>Standard No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS :13947</td>
<td>LV switch gear and control gear</td>
</tr>
<tr>
<td>IS :10118</td>
<td>Code of practice for selection, installation and maintenance of switchgear and control-gear</td>
</tr>
<tr>
<td>IS :4237</td>
<td>General requirements for Switchgear and Control gear for voltages not exceeding 1000 V.</td>
</tr>
<tr>
<td>IS :13703</td>
<td>LV fuses for voltages not exceeding 1000 V AC</td>
</tr>
<tr>
<td>IS :12021</td>
<td>Specification of control transformers</td>
</tr>
<tr>
<td>IS :2705</td>
<td>Voltage Transformers</td>
</tr>
<tr>
<td>IS :11353</td>
<td>Guide for uniform system of marking and identification of conductors and apparatus terminals</td>
</tr>
<tr>
<td>IS :2147</td>
<td>Degree of protection provided by enclosures for low voltage switchgear and Control gear</td>
</tr>
<tr>
<td>IS :3043</td>
<td>Code of practice for earthing</td>
</tr>
<tr>
<td>IS :6005</td>
<td>Code of practice of phosphating iron and steel.</td>
</tr>
<tr>
<td>IS :3202</td>
<td>Code of practice for climate proofing of electrical equipment</td>
</tr>
<tr>
<td>IS :2629</td>
<td>Hot dip galvanising</td>
</tr>
<tr>
<td>IS :5082</td>
<td>Wrought Aluminium and Aluminium alloys for electrical purposes</td>
</tr>
<tr>
<td>IS :722</td>
<td>A C Electricity Meters</td>
</tr>
<tr>
<td>IS :1248</td>
<td>Electrical Indicating instruments</td>
</tr>
<tr>
<td>IS :3231</td>
<td>Electrical relays for power system protection</td>
</tr>
<tr>
<td>IS :5</td>
<td>Colors for ready-mixed paints and enamels.</td>
</tr>
<tr>
<td>IS :1554</td>
<td>PVC insulated cables for working voltages up-to and including 1100V</td>
</tr>
<tr>
<td>IS :8544</td>
<td>AC motor starters of voltage not exceeding 1000 volts</td>
</tr>
<tr>
<td>IS :8686</td>
<td>Static Relays</td>
</tr>
<tr>
<td></td>
<td>IE Rules 1956</td>
</tr>
</tbody>
</table>
Nothing in this specification shall be construed as to relieve the bidder of the responsibility for correctness of the design and construction of the equipment. Wherever the service conditions and requirements laid in this specification differ from applicable standards, the conditions specified here in shall prevail.

Equipment complying with any other authoritative/internationally recognised standards such as IEC, BS, VDE etc. shall also be considered if it ensures performance equivalent or superior to Indian Standards. In such cases, the bidder shall clearly indicate the standard adopted and furnish a copy of the latest version in English along-with the bid and bring out the salient features for comparison.

The standard specifications and code of practices referred to herein shall be the latest edition including all applicable official amendments and revisions as published one month prior to the date of opening of bids. In case of conflict between this specification and those (IS Codes, Standards etc.) referred to herein, the former shall prevail.

\begin{center}
\begin{tabular}{|c|c|}
\hline
\textbf{SERVICE CONDITION} & \\
\hline
Ambient air temperature & 5°C to 50°C \\
Altitude & Maximum up to 1000 M above MSL. \\
Relative Humidity & Approximately 97 \%.
\hline
Pollution degree & Degree 4 as per IS : 13947 (Part I) (i.e. the pollution generates persistent conductivity caused by conductive dust) \\
\hline
\end{tabular}
\end{center}

\begin{center}
\begin{tabular}{|c|c|}
\hline
\textbf{Operating Conditions} & \\
\hline
Nominal system Voltage & 440 V (+/- 10\%) \\
Supply Frequency & 50 Hz (-5\% to +3\%) \\
System earthing & Effectively earthed \\
Highest Fault Level & 31 MVA \\
\hline
\end{tabular}
\end{center}

\section*{CONSTRUCTIONAL DETAILS OF SWITCH BOARDS/MCC}

\subsection*{4.1}
All Switchboards, i.e., 440 V Switchgears, Motor Control Centres (MCCs), A.C. Distribution Boards (ACDBs) shall be of metal enclosed, indoor, floor-mounted, free-standing type. Each panel shall comprise one or more of the modules mentioned in Annexure-A.

\subsection*{4.2}
All switchboard frames and load bearing members shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness not less than 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness not less than 1.6 mm. Doors and covers shall also be of cold rolled sheet steel of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary. The gland plates thickness shall be 3.0 mm (minimum) for hot/cold rolled sheet steel and 4.0 mm (minimum) for non-magnetic material.

\subsection*{4.3}
All panel edges and cover/door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members. The top covers of the panels should be designed such that they do not permanently bulge/bend by the weight of maintenance personnel working on it.
4.4 The complete structures shall be rigid, self-supporting, free from flaws, twists and bends. All cutouts shall be true in shape and devoid of sharp edges.

4.5 All switchboards shall be of dust-proof and vermin-proof construction and shall be provided with a degree of protection of IP 52 as per IS:2147. However, the busbar chambers having a degree of protection of IP 42 are also acceptable where continuous busbar rating is 1600 A and above. Provision shall be made in all compartments for providing IP 52 degree of protection, when circuit-breaker or module trolley has been removed. All cutouts shall be provided with synthetic rubber gaskets. The switchboards which are meant for outdoor duty shall be provided with degree of protection of IP 54 as per IS:2147.

4.6 Provision of louvers on switchboards would not be preferred. However, louvers backed with metal screen are acceptable on the busbar chambers where continuous busbar rating is 1600 A and above.

4.7 All switchboards shall be of uniform height not exceeding 2100 mm

4.8 Switchboards shall be easily extendable on both sides by the addition of vertical sections after removing the end covers.

4.9 Switchboards shall be supplied with base frames made of structural steel sections along-with all necessary mounting hardware required for welding down the base frame to the foundation/steel insert plates. The base frame height shall be such that floor finishing (50 mm thick) after erection of the switchboards does not obstruct the movement of doors, covers, withdraw-able modules etc.

4.10 All switchboards shall be divided into distinct vertical sections (panels), each comprising of the following compartments.

a) **Busbar Compartment**
   A completely enclosed bus bar compartment shall be provided for the horizontal and vertical busbars. Bolted covers shall be provided for access to horizontal and vertical busbars and all joints for repair and maintenance which shall be feasible without disturbing any feeder compartment. Auxiliary and power busbars shall be in separate compartments.

b) **Switchgear/feeder Compartment**
   All equipments associated with an incomer or outgoing feeder shall be housed in a separate compartment of the vertical section. The compartment shall be sheet steel enclosed on all sides with the withdraw-able units in position or removed. Insulating sheet at rear of the compartment is also acceptable. The front of the compartment shall be provided with the hinged single leaf door with captive screws for positive closure.

c) **Cable Compartment or Cable Alley**
   A full-height vertical cable alley of minimum 175 mm width shall be provided for power and control cables. Cable alley shall have no exposed live parts and shall have no communication with busbar compartment. Cable terminations located in cable alley shall be suitably shrouded to prevent accidental contact
by falling of tools etc. For distribution boards, the partition between the feeder compartment and cable alley made of FRP sheet may also be offered. It shall be of such construction as to allow cable cores with lugs to be easily inserted in the feeder compartment for termination. Wherever cable alleys are not provided for distribution boards, segregated cable-boxes with complete shrouding for individual feeders shall be provided at the rear for direct termination of cables in each individual feeder. For circuit breaker external cable connections a separately enclosed cable compartment shall also be acceptable. The Contractor shall furnish suitable plugs to cover the cable openings in the partition between feeder compartment and cable alley, for at least 50% of the total number of feeders. Cable alley door shall be hinged.

d) **Control Compartment**

A separate compartment shall be provided for relays and other control devices associated with a circuit breaker.

4.11 Sheet steel barriers shall be provided between two adjacent vertical panels running to the full height of the switchboard, except for the horizontal busbar compartment. Synthetic rubber gasket shall be provided between the panel sections to avoid ingress of dust into panels. Each shipping section shall have full metal sheets at both ends for transport and storage.

4.12 After isolation of power and control circuit connections it shall be possible to safely carryout maintenance in a compartment with the busbar and adjacent circuit live. Necessary shrouding arrangement shall be provided for this purpose. Wherever two breaker compartments are provided in the same vertical section, insulating barriers and shrouds shall be provided in the rear cable compartment to avoid accidental touch with the live parts of one circuit when working on the other circuit.

4.13 All 440 V switchgear (circuit-breaker) panels shall be of single-front type MCCs and ACDBs shall be of single-front construction. All single-front switchboards shall be provided with single-leaf, hinged or bolted covers at the rear. The bolts shall be of captive type. The covers shall be provided with "DANGER" labels. All panel doors shall open by 90 degree or more.

4.14 All ACDBs shall be of fixed module type. All 415 V circuit breaker modules and MCC modules shall be of fully draw-out type having distinct 'Service' and 'Test' positions. The equipment pertaining to a draw-out type incomer or feeder module shall be mounted on a fully withdraw-able chassis which can be drawn out without having to unscrew any wire or cable connection. Suitable arrangement with cradle/rollers and guides shall be provided for smooth movement of the chassis. For modules of size more than half the panel height, double guides shall be provided for smooth removal or insertion of module. All identical module chassis of same size shall be fully interchangeable without having to carryout any modifications.

4.15 All disconnecting contacts for power and control circuits of draw-out modules shall be of robust and proven design, fully self-aligning and spring-loaded. Both fixed and moving contacts shall be silver-plated and replaceable. The spring-loaded power and control draw-out contacts shall be on withdraw-able chassis and same on fixed portion shall not be accepted. Detachable plug and socket type control terminals shall also be acceptable.
4.16 Individual opening in the vertical bus enclosure shall permit the entry of moving contacts from the draw-out module into vertical droppers.

4.17 All equipments and components shall be neatly arranged and shall be easily accessible for operation and maintenance. The internal layout of all modules shall be subject to Purchaser's approval. The Contractor shall submit dimensional drawings showing complete internal details of busbars and module components, for each type and rating for approval of Purchaser.

4.18 However, the Purchaser reserves the right to alter the cable entries top or bottom, if required, during detailed engineering, without any additional commercial implication.

4.19 Each switchboard shall be provided with undrilled, removable type gland plate which shall cover the entire cable alley. Bidder shall ensure that sufficient cable glanding space is available for all the cables coming in a particular section through gland plate. For all single core cables, gland plate shall be of non-magnetic material. The gland plate shall preferably be provided in two distinct parts for the ease of terminating additional cables in future. The gland plate shall be provided with gasket to ensure enclosure protection.

4.20 The composition and disposition of various modules in a switchboard shall be finalised during detailed engineering. The Bidder shall include in his quoted price the cost of any adoption panel/dummy panel required to meet various configuration arrangement of busbars adopted by the Bidder. The switchboards fed from outdoor transformers shall be connected through cables. Busduct connections wherever applicable shall be preferably in a straight line alignment.

4.21 **Clearances**

The minimum clearance in air between phases and between phases and earth for the entire run of horizontal and vertical busbars and bus-link connections at circuit-breaker shall be 25 mm. For all other components the clearance between 'two live parts', 'a live part and an earthed part', shall be atleast ten (10) mm throughout. Wherever it is not possible to maintain these clearances, insulation shall be provided by sleeving or barriers. However, for horizontal and vertical busbars the clearances specified above should be maintained even when the busbars are sleeved or insulated. All connections from the busbars up-to switch/fuses shall be fully shrouded/insulated and securely bolted to minimise the risk of phase to phase and phase to earth short circuits.

5.0 **POWER BUSBARS AND INSULATORS**

5.1 All 440 V Switchboards, MCCs and ACDBs shall be provided with three phase and neutral busbars.

5.2 All busbars and jumper connections shall be of high conductivity aluminium alloy/copper of adequate size.

5.3 The cross-section of the busbars shall be uniform throughout the length of switchboard and shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents. Neutral busbar short circuit strength shall be same as main busbars.
5.4 All busbars shall be adequately supported by non-hygroscopic, non-combustible, track-resistant and high strength sheet moulded compound or equivalent type polyester fibre glass moulded insulators. Separate supports shall be provided, for each phase and neutral busbar. If a common support is provided, anti-tracking barriers shall be provided between the supports. Insulator and barriers of inflammable material such as Hylam, shall not be accepted. The busbar insulators shall be supported on the main structure.

5.5 All busbar joints shall be provided with high tensile steel bolts, belleville/spring washers and nuts, so as to ensure good contacts at the joints. Non-silver plated busbar joints shall be thoroughly cleaned at the jointed locations and a suitable contact grease shall be applied just before making a joint. All bolts shall be tightened by torque spanner to the recommended value. The overlap of the busbars at each joint surface shall be such that the length of overlap shall be equal to or greater than the width of the busbar. All copper to aluminium joints shall be provided with suitable bi-metallic washers.

5.6 All busbars shall be color coded as per IS : 375.

5.7 Wherever the busbars are painted with black matt paint, the same should be suitable for temperature encountered in the switchboard under normal operating conditions.

5.8 The Bidder shall furnish calculations establishing the adequacy of busbar sizes for specified current ratings.

5.9 The neutral bus in MCC shall be connected to earth bus at two points by separate vertical droppers which shall be insulated from MCC enclosure. The neutral bus shall not be earthed in all the other boards in which incomers are not from transformers.

6.0 **AUXILIARY BUSBARS AND CONTROL TRANSFORMERS**

6.1 **AC Control Supply Bus bar**
Each bus-section of all Switchgears and MCCs shall be provided with one (1) no. 440 V/110V control transformer as shown in enclosed Drawing. The 110 V AC control supply from the control transformers shall be run through the MCC by means of two sets of control supply busbars of electrolytic copper. In case of one transformer failure, whole bus section can be fed through single transformer. The control supply to different modules shall be tapped individually from the control supply busbars. One pole of secondary winding of control transformers shall be solidly grounded through a test link. The transformer body shall be earthed at two points.

6.02 **DC Control Supply Bus bars**
For PLC based control system, DC supply to PLC unit including relays shall be provided with one (1) no. of 440 V/220V control transformer with inverter unit in each section of the MCC. The Bidder shall provide suitable terminals, switch etc. to receive the DC supply and distribute the same through above mentioned control busbars to the required modules of the respective section. The DC control supply bus of one section shall be coupled to the control
supply of other section through a switch located in the bus-coupler breaker panel. The DC supply to the bus-coupler breaker may be given from any of the control buses.

6.03 **Space Heater Busbars**

Panel and motor space heaters shall be fed from separate AC auxiliary busbars running throughout the switchboard. The supply for these busbars shall be tapped from incomers before the isolating switch/circuit breaker. Incoming circuit to space-heater bus shall have an isolating switch, HRC fuse and neutral link of suitable rating. Suitable terminals shall also be provided to facilitate energisation of space-heater bus from outside during long shutdowns of unit/switchboard.

6.04 **Control Transformers**

The control transformers shall be 440 V/110 V, dry type, of insulation class B or better. The sizing of Control transformers shall be carried out by Bidder considering the actual load of power contactors, auxiliary contactors, indicating lamps and other equipments in the module circuit. An additional load of 15 watts should also be considered for each module, for remote auxiliary relays and lamps to be connected in the control circuit of modules. Bidder shall also ensure that control transformers are adequately designed for meeting the momentary loading requirements and the voltage drop during this condition shall not be more than 5%.

7.0 **EARTH BUS AND EARTHING**

7.1 A galvanised steel earth bus shall be provided at the bottom of each panel and shall extend throughout the length of each switchboard. It shall be welded/bolted to the framework of each panel and breaker earthing contact bar. Vertical earth bus shall be provided in each vertical section which shall in turn be bolted/welded to main horizontal earth bus.

7.2 The earth bus shall have sufficient cross section to carry the momentary short circuit and short time fault current to earth, without exceeding the allowable temperature rise.

7.3 Suitable arrangements shall be provided at each end of the horizontal earth bus for bolting to earthing conductors. The horizontal earth bus shall project out of the switchboard ends and shall have predrilled holes for this connection. All joint splices to earth bus shall be made through at least two bolts and taps by proper lug and bolts connection.

7.4 All non-current carrying metal work of the switchboard shall be effectively bonded to the earth bus. Electrical conductivity of the whole switchgear enclosure framework and truck shall be maintained even after painting.

7.5 The carriage and breaker frame shall get earthed while being inserted in the panel and positive earthing of the breaker frame shall be maintained in all positions, i.e. SERVICE & ISOLATED, as well as throughout the intermediate travel.
7.6 Each module frame shall get engaged to the vertical earth bus before the disconnecting contacts on the module are engaged to the vertical busbars.

7.7 All metallic cases of relays, instruments and other panel-mounted equipments shall be connected to earth by independent stranded copper wire of size not less than 2.5 sq. mm. All the equipment mounted on the door shall be earthed through flexible wire/braids. Insulation color code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connectors, soldering is not acceptable. Looping of earth connections which would result in loss of earth connections to other devices, when a device is removed, is not acceptable. However, looping of earth connections between equipments to provide alternative paths to earth bus is acceptable.

7.8 VT and CT secondary neutral point earthing shall be at one place only, i.e., on the terminal block. Such earthing shall be made through links so that earthing of one secondary circuit shall be removed without disturbing the earthing of other circuit.

7.9 All hinged doors having potential carrying equipment mounted on it shall be earthed by flexible wire/braid. For doors not having potential carrying equipment mounted on it, earth continuity through scraping hinges/hinge pins of proven design may also be acceptable. The Bidder shall establish earth continuity at site also.

8.0 CIRCUIT BREAKERS

8.1 Circuit breakers shall be three pole, air break, horizontal draw-out type, and shall have fault making and breaking capacities. The operating duty shall be O-3 min-CO-3 min-CO. The circuit breakers which meet specified parameters of continuous current rating and fault making/breaking capacity only after provision of cooling fans or special device shall not be acceptable.

8.2 Circuit breakers along-with its operating mechanism shall be provided with suitable arrangement for easy withdrawal. Suitable guides shall be provided to minimise misalignment of the breaker.

8.3 There shall be "SERVICE", "TEST" and "ISOLATED" positions for the breakers. In "TEST" position the circuit breaker shall be capable of being tested for operation without energising the power circuits i.e. the power contacts shall be disconnected, while the control circuits shall remain undisturbed. Locking facilities shall be provided so as to prevent movement of the circuit breaker from the "SERVICE", "TEST" or "ISOLATED" position. It shall be possible to close the door in "TEST" position.

8.4 All circuit breakers shall have short circuit releases and shunt trip coil irrespective of the type of operating mechanism.

8.5 All circuit breakers shall be provided with "4 NO" and "4 NC" potential free auxiliary contacts. These contacts shall be in addition to those required for internal mechanism of the breaker and should be directly operated from breaker operating mechanism.
8.6 Suitable mechanical indications shall be provided on all circuit breakers to show "OPEN", "CLOSE", "SERVICE", "TEST" and "SPRING CHARGED" positions.

8.7 Main poles of the circuit breakers shall operate simultaneously in such a way that the maximum difference between the instants of contacts touching during closing shall not exceed half a cycle of rated frequency.

8.8 All circuit breakers shall be provided with the following interlocks:

i) Movement of a circuit breaker between "SERVICE" and "TEST" position shall not be possible unless it is in open position. Attempted withdrawal of a closed circuit breaker shall preferably not trip the circuit breaker. In cases the offered circuit breaker trips on attempted withdrawal as a standard interlock, it shall be ensured that sufficient contact exist between the fixed and draw-out contact at the time of breaker trip, so that no arcing takes place even with the breaker carrying its full rated current.

ii) Closing of a circuit breaker shall not be possible unless it is in "SERVICE" position, "TEST" position or in "ISOLATED" position.

iii) Circuit-breaker cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker carriage to cover the stationary isolated contacts when the breaker is withdrawn. It shall however be possible to open the shutters intentionally against pressure for testing purposes.

iv) A breaker of particular rating shall be prevented from insertion in a cubicle of a different rating.

v) Circuit breakers shall be provided with coded key/electrical interlocking devices.

8.9 Circuit breaker shall be provided with electrical anti-pumping and trip free feature even if mechanical anti-pumping feature is provided.

8.10 Mechanical tripping shall be possible by means of front mounted Red trip push button. In case of electrically operated breakers these push buttons shall be shrouded to prevent accidental operation.

8.11 Means shall be provided to slowly close the circuit breaker in "ISOLATED", if required, for inspection and setting of contacts. In "SERVICE" position slow closing shall not be possible.

8.12 Complete shrouding/segregation shall be provided between incoming and outgoing bus links of breakers. In case of bus coupler breaker panels the busbar connection to and from the breaker terminals shall be segregated such that each connection can be approached and maintained independently with the other bus section live. Dummy panels if required to achieve the above feature shall be included in the Bidder's scope of supply.

8.13 Circuit breaker shall be provided with following mechanism:

8.13.1 Power Operated Mechanism

i) Power operated mechanism shall be provided with a universal motor suitable for operation on 110V AC Control supply, with voltage variation from 85% to 110% rated voltage. Motor insulation shall be class "E" or better.
ii) The motor shall be such that it requires not more than 30 seconds for fully charging the closing spring at minimum available control voltage.

iii) Once the closing springs are discharged, after one closing operation of circuit breaker, it shall automatically initiate recharging of the spring.

iv) The mechanism shall be such that as long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. After failure of power supply at least one open-close-open operation shall be possible.

v) Provision shall be made for emergency manual charging and as soon as this manual charging handle is coupled, the motor shall automatically get mechanically decoupled.

vi) All circuit breakers shall be provided with closing and trip coils. The closing coil shall operate correctly at all values of voltage between 85% to 110% of rated control voltage. The trip coil shall operate satisfactorily at all values of voltage between 70% to 110% of rated control voltage.

vii) Provision for mechanical closing of the breaker only in "TEST" and "ISOLATED" positions shall be made. Alternately, the mechanical closing facility shall be normally made inaccessible, accessibility being rendered only after deliberate removal of shrouds.

8.14 **Telescopic Trolley**

One (1) Telescopic trolley shall be provided for maintenance of circuit-breaker module in a cubicle. The trolley shall be such that the topmost breaker module can be withdrawn on the trolley and can be lowered for maintenance purpose. The telescopic trolley shall be such that all type, size and rating of breaker can be withdrawn/inserted of a particular switchgear.

9.0 **AIR BREAK SWITCHES**

9.1 Air break switches shall be of heavy duty, single throw, group operated, load break, fault make type when associated with fuses and complying with IS:4064. All switches for motor circuits shall be of utilisation category AC-23 with 1NO+1NC auxiliary contact which shall be wired to the control circuit as shown in the schematic drawings. All switches for other outgoing feeders shall be of utilisation category AC-22.

9.2 Continuous current rating of the switches shall be selected for various feeders.

9.3 The combination of switch-fuse unit would be preferred. However, if separate switch and fuses are provided, fuses shall be located before switch. In case two switch fuse units are kept adjacent in the same module, proper identification and shrouding on the rear side shall be done.

9.4 The main switches shall be operable from outside the module door. The switch handle shall clearly indicate the position of switch. Switch operating handles shall be provided with padlocking facilities to lock them in "OFF" position. However, incomer switches of switchboards shall be provided with padlocking facility in both "ON" and "OFF" positions.
9.5 Interlocks shall be provided such that the cubicle door will not open when the
switch is in closed position and the switch will close only when the door is
closed. However, suitable means shall be provided to intentionally defeat
these interlocks.

9.6 Switches and fuses for AC control supply and heater supply wherever
required, shall be mounted inside the cubicles. Toggle switches shall not be
accepted.

9.7 Even for a single feeder the Bidder shall provide TPN switch, fuse-bases and
cable/link connections between switch/fuse and vertical busbars for all the
three phases, so that changing from single phase feeder to three phase
feeder is possible without any modification other than inserting fuses at site.

10.0 CONTROL AND SELECTOR SWITCHES

10.1 Control and Selector switches shall be of rotary type, with escutcheon plates
clearly marked to show the function and positions. The switches shall be of
sturdy construction suitable for mounting on panel front. Switches with
shrouding of live parts and sealing of contacts against dust ingress shall be
preferred.

10.2 Circuit breaker control switches shall have three positions and shall be spring
return to "NEUTRAL" from "CLOSE" and "TRIP" positions and shall have
pistol grip handles. The control switch shall have adequate number of
contacts in each position and shall have at least two (2) contacts closing in
'Close' position, and two (2) contacts closing in 'Trip' position unless specified
otherwise. Lost motion device contact requirement, if any shall be provided.

10.3 Circuit breaker selector switches for motor feeders shall have three stay put
positions marked "Switchgear", "Normal" and "Trial" respectively. They shall
have at least three contacts for each of the three positions and shall have
black spade handles. Circuit breaker selector switches for other feeders shall
have two stay put positions marked "Switchgear" and "Normal" with two
contacts for each of the two positions.

10.4 Ammeter and voltmeter selector switches shall have four stay put positions
with adequate number of contacts for 3-phase 4-wire system. These shall
have oval handles. Ammeter selector switches shall have make before break
type contacts to prevent open circuit of CT secondary.

10.5 Contacts of the switches shall be spring assisted and shall be of suitable
material to give a long trouble free service.

10.6 The contact ratings shall be at least the following:
   i) Make and carry, continuously, 10 A 110 V AC.
   ii) Breaking current at 110 V AC and 0.3 lagging p.f., 5A.

11.0 CONTACTORS

11.1 Motor starter contactors shall be of air break, electro-magnetic type rated for
uninterrupted duty as per IS :2959.

11.2 Contactors shall be double-break, non-gravity type and their main contacts
shall be silver faced.

11.3 Direct-on-line contactors shall be of utilisation category AC3. Reversing
starters shall comprise of Forward and Reverse contactors mechanically and
electrically interlocked with each other. These contactors shall be of utilisation category AC4.

11.4 The number of normally open (NO) and normally closed (NC) auxiliary contacts of a contactor shall be as per requirement shown in the respective module drawings. It shall, however, be not less than 2 NO+2NC.

11.5 Operating coil of contactors shall be of 110 V AC unless otherwise specified elsewhere. The contactor shall operate satisfactorily between 85% to 110% of the rated voltage. The contactor shall not drop out at 70% of the rated voltage but shall definitely drop out at 20% of the rated voltage.

12.0 **FUSES**

12.1 All fuses shall be of HRC cartridge fuse link type. Screw type fuses shall not be accepted. Fuses for AC circuits shall be rated for 80 KA rms (prospective) breaking capacity at 440 V AC.

12.2 Fuse shall have visible operation indicators. Insulating barriers shall be provided between individual power fuses.

12.3 Fuse shall be mounted on insulated fuse carrier which is mounted on fuse bases. Wherever it is not possible to mount fuses on carriers, fuses shall be directly mounted on plug-in type of bases. In such cases one set of insulated fuse pulling handles shall be supplied with each switchboard.

12.4 Fuse ratings shall be selected by the Bidder for various feeders. Switch rating shall in no case be less than the fuse rating.

12.5 The Neutral links shall be mounted on fuse carriers which shall be mounted on fuse bases.

13.0 **INSTRUMENT TRANSFORMERS**

13.1 All current and voltage transformers shall be completely encapsulated cast resin insulated type suitable for continuous operation at the temperature prevailing inside the switchgear enclosure, when the switchboard is operating at its rated condition and the specified ambient temperature. The class of insulation shall be 'E' or better.

13.2 All instrument transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum r.m.s short circuit breaking and peak making current ratings of the associated switchgear.

13.3 All instrument transformers shall have clear indelible polarity markings. All secondary terminals shall be wired to separate terminals on an accessible terminal block where star point formation and earthing shall be done.

13.4 Current transformers may be multi or single core type. All voltage transformers shall be single phase type.

13.5 The bus VTs shall be housed in separate compartment. All VTs shall have readily accessible HRC current limiting fuses on both primary and secondary sides.

13.6 All CTs shall be provided with supports independent of busbar/ busbar supports.

13.7 The CTs shall be located in such a way that they can be easily approached for maintenance without necessitating shut down of adjacent feeders.
13.8 The metering CTs shall be of Class 1 accuracy and adequate VA burden. The Protection CTs shall be of 5P accuracy class with adequate burden.

14.0 RELAYS & TIMERS

14.1 All relays and timers in protective circuits shall be flush mounted on panel front with connections from the inside. They shall have transparent, dust tight covers removable from the front. All protective relays shall have a draw-out construction for easy replacement from the front. They shall either have built in test facilities or shall be provided with necessary test blocks and test switches located immediately below each relay. The auxiliary relays and timers may be furnished in non-draw out cases.

14.2 All AC relays shall be suitable for operation at 50 Hz with 110 Volt VT secondary and 1A or 5A CT secondary.

14.3 Protective relays, auxiliary relays and timers shall be provided with hand reset operation indicators for analysing the cause of operation.

14.4 All relays shall withstand a test voltage of 2.5 KV AC rms for one second or 2 KV AC rms for one minute. The accuracy class shall be 5 of IS : 3231.

14.5 All fuse protected contactor controlled motor and actuator starters shall be provided with three element, ambient temperature compensated, time lagged, hand reset type thermal overload relays with single phasing protection using differential movement and bimetallic strips. The single phasing protection shall operate even with 100% of the set current flowing in two of the phases and no current in the third phase. The setting ranges shall be properly selected to suit the motor ratings and shall be adjustable type. These relays shall have a separate black colored hand reset push button mounted on compartment door and shall have at-least one changeover contact. Heavy duty starting overload relays shall be provided for modules controlling motors with long starting time. The requirement shall be finalised during detailed engineering.

14.6 All releases in circuit breakers shall conform to IS : 13947. The releases shall be instantaneous or time delayed as per the requirement mentioned in module description. The releases shall have an operation indicator. The time delay range of the release shall be such that proper discrimination can be achieved with one breaker with instantaneous release and three consecutive upstream breakers with time delayed release. The Bidder shall clearly bring out in his offer how the above can be achieved with his recommended settings for each breaker. The instantaneous release used for motor feeders shall be co-ordinated such that it does not operate with motor starting current.

14.7 The DC auxiliary relays for PLC system shall be designed for 220 V DC unless otherwise specified and shall operate satisfactorily between 75% and 110 % of the rated voltage. Relays shall have adequate thermal capacity for continuous operation in circuit in which they are used. For PLC-controlled modules the coupling relays shall be provided by Bidder. The other parameters of these relays shall be same as Cl.No. 14.4 except for peak inverse voltage of diode which will be twice the rated voltage of coil.
15.0 **INDICATING INSTRUMENTS**

15.1 All indicating and integrating meters shall be flush mounted on panel front. The instruments shall be of at least 96 mm. square size with 90 degree linear scales, and shall have an accuracy class of 2.0 or better. The covers and cases of instruments and meters shall provide a dust and vermin proof construction.

15.2 All instruments shall be compensated for temperature errors and factory calibrated to directly read the primary quantities. Means shall be provided for zero adjustment without removing or dismantling the instruments.

15.3 All instruments shall have white dials with black numerals & lettering. Black knife edge pointer shall be provided for meters.

15.4 Ammeters provided for motor feeders shall have a compressed scale at the upper current region to cover the starting current upto 6.0 times the CT primary current.

16.0 **PUSH BUTTONS**

16.1 Push buttons shall be of spring return, push-to-actuate type. Their contacts shall be rated to make, continuously carry and break 10 A at 110 V AC.

16.2 All push buttons shall have one normally open and one normally closed contact unless specified otherwise. The contact faces shall be of silver alloy.

16.3 All push buttons shall be provided with integral escutcheon plates marked with its function.

16.4 The colour of the button shall be as follows:
- **Green** for motor START, breaker CLOSE, commands.
- **Red** for motor TRIP, breaker OPEN, commands
- **Black** for all annunciation functions, overload, reset and miscellaneous commands including reversal.

16.5 All push buttons on panels shall be located in such a way that Red push buttons shall always be to the left of Green push-buttons. In case of clinker grinder etc. the push buttons would be black-red-green from left to right.

16.6 All emergency push buttons shall have mushroom knobs.

17.0 **INDICATING LAMPS**

17.1 Indicating lamps shall be of the panel mounting, filament type and low watt consumption. Lamps shall be provided with non-hygroscopic series resistors preferably built-in the lamp assembly. The lamps shall have escutcheon plates marked with its function wherever necessary.

17.2 Lamps shall have translucent lamp-covers of the following colors, as warranted by the application.
- **Red** for motor ON, valve/damper OPEN, breaker CLOSE
- **Green** for motor OFF, valve/damper CLOSE, breaker OPEN
- **White** for motor AUTO TRIP
- **Blue** for all healthy conditions (e.g. CONTROL SUPPLY ON, and also for "SPRING CHARGED")
- **Amber** for all Alarm Conditions (e.g. overload). Also for "SERVICE" and "TEST" position indications.
17.3 Bulbs and lamp covers shall be easily replaceable from the front of the cubicle. The method of mounting indicating lamp fittings on panels shall prevent their rotation under the action of lamp removal or replacements, reliance upon the tightness of ring nut for the purpose is not sufficient.

17.4 Indicating lamps should be located just above the associated push-button/control switches. Red lamps shall invariably be located to the right of green lamps. In case a white lamp is also provided, it shall be placed between the red and green lamps along the centre line of control switch/push button pair. Blue and Amber should normally be located above the Red and Green lamps.

17.5 When associated with push-buttons, red lamps shall be directly above the green push-button and green lamp shall be directly above the red push button.

17.6 All indicating lamps shall be suitable for continuous operation at 90% to 110% of their rated voltage.

18.0 SPACE HEATER

18.1 Space heaters shall be provided in the switchboards wherever the manufacturer considers them necessary and recommends their provision for preventing harmful moisture condensation.

18.2 The space heaters shall be suitable for continuous operation on 240 V AC, 50 Hz, single phase supply and shall be automatically controlled by thermostats. Necessary switches and fuses shall also be provided.

18.3 The circuit for each panel and motor space heater should have an isolating switch, HRC fuse and isolating link. In addition, the space heater circuit of each panel shall also have a thermostat of suitable rating.

19.0 INTERNAL WIRING

19.1 All switchboards shall be supplied completely wired internally up-to the terminals ready to receive external cables.

19.2 All inter-cubicle and inter-panel wiring and connections between panels of same switchboard including all bus wiring for AC supplies shall be provided by the Bidder.

19.3 All auxiliary wiring shall be carried out with 650 V grade, single core, stranded copper conductor, color coded, PVC insulated wires. Conductor size shall be 22 1.5 mm (min.) for control circuit wiring and 2.5 mm (min.) for CT and space heater circuits.

19.4 Extra flexible wires shall be used for wiring to devices mounted on moving parts such as hinged doors. The wire bunches from the panel inside to the doors shall be properly sleeved or taped.

19.5 All wiring shall be properly supported, neatly arranged, readily accessible and securely connected to equipment terminals and terminal blocks.
19.6 All internal wiring terminations shall be made with solder less crimping type tinned copper lugs which shall firmly grip the conductor or an equally secured method. Similar lugs shall also be provided at both ends of component to component wiring. Insulating sleeves shall be provided over the exposed parts of lugs to the extent possible.

19.7 Engraved core identification ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. The ferrule shall be of self locking type of ‘Novoflex’ or equivalent make. The wire identification marking shall be in accordance with IS : 375. Red Ferrules should be provided on trip circuit wiring.

19.8 Wiring for equipment, which are to be supplied by the Purchaser/Other Contractor and for which the Contractor has to provide mounting arrangement in his panels, shall also be provided by the Contractor, upto the terminal blocks.

19.9 All connections from vertical busbars for individual modules above 100 A shall be by Copper links only. The cable connections for modules less than 100A shall be selected in such a way that there will not be any melting/shorting in case of a short circuit inside the module and the cable shall have current rating to carry the let through energy of the corresponding fuses in case of a fault. The insulation of the cable and its cross section shall be decided considering the high ambient temperature within the module. For all modules where use of cable is envisaged by the Contractor specific approval from the Purchaser regarding cable details are to be taken. For power wiring color coded wire insulation/tapes shall be provided.

20.0 CONTROL TERMINAL BLOCKS

20.1 Control terminal blocks shall be of 650 Volts grade, rated for 10 Amps and in one piece moulding. It shall be complete with insulating barriers, clip-on type terminals and identification strips. Marking on terminal strip shall correspond to the terminal numbering on wiring diagrams. It shall have insulating material of Melanine conforming to relevant code.

20.2 Terminal blocks for CT & VT secondary leads shall be provided with test links and isolating facilities. CT secondary leads shall be provided with short circuit and earthing facilities.

20.3 In all circuit breaker panels at least 10% spare terminals for external connections shall be provided and these spare terminals shall be uniformly distributed on all terminal blocks.

20.4 All terminal blocks shall be suitable for terminating on each side two (2) nos. 2 stranded copper conductors of size up-to 2.5 mm each.

20.5 All terminals shall be numbered for identification and grouped according to the function. Engraved white-in-black labels shall be provided on the terminal blocks.

20.6 Wherever duplication of a terminal block is necessary it shall be achieved by solid bonding links.

20.7 Terminal blocks shall be arranged with at-least 100 mm clearance between two sets of terminal blocks. The minimum clearance between the first row of terminal blocks and the associated cable gland plate shall be 250 mm.
21.0 **POWER CABLE TERMINATION**

21.1 Cable termination compartment and arrangement for power cables shall be suitable for heavy duty, 1.1 KV grade, stranded aluminium conductor, PVC/XLPE insulated, armoured and PVC sheathed cables. All necessary cable terminating accessories such as supporting clamps and brackets, power cable lugs, hardware etc. shall be provided by the Bidder to suit the final cable sizes.

21.2 All power cable terminals shall be of stud type and the power cable lugs shall be of tinned copper solder less crimping ring type conforming to IS : 8309. All lugs shall be insulated/sleeved.

22.0 **NAME PLATES AND LABELS**

i) The MCC shall be provided with prominent, engraved identification plates. The module identification plate shall clearly indicate the feeder number and feeder designation as indicated elsewhere.

ii) The name plates shall be of non rusting metal with white non graved letterings on black back grounds. Inscriptions and lettering sizes shall be subject to purchaser's approval.

iii) Suitable stenciled paint mark shall be provided in side the panel /module for identification of all equipments in addition to the plastic sticker labels, if provided. The labels shall be positioned so as to be clearly visible. The labels shall bear the device number as indicated in the approved module wiring drawing.

iv) Caution plate with the inscription "WARNING LIVE TERMINALS" shall be provided at all joints where the terminals are likely to remain live and isolation is possible only at remote end.

23.0 **PAINTING**

The sheet steel work shall be pre treated, in tanks, in accordance with relevant code. Degreasing shall be done by alkaline cleaning. Rust and scales shall be removed by pickling with acid. After pickling phosphate coating of class C in accordance with relevant code shall be provided. The phosphated surfaces shall be applied with stove lead oxide primer coating followed by two coats of finishing synthetic enamel paints. Electrostatic painting is also acceptable. Finishing paint on panels shall be shade 692 (smoke grey) in accordance with relevant code. The inner surface of the panels shall be glossy white. For electrostatic or powder painting manufacturer's standard shade for inner surface of the panels shall also be acceptable. Each coat of finishing paint shall be properly stoved. The finishing paint thickness shall not be less than 50 microns. Finished surfaces shall be coated by peel able compound by spraying method for protection against scratches, grease, dirt & oil spots. All hardware shall be nickel chromium plated or zinc passivated.

24.0 **GASKETS**

The gaskets wherever specified shall be of good quality synthetic rubber with good ageing, compression and oil resistant characteristic suitable for panel application.
25.0 PERFORMANCE

25.1 TEMPERATURE-RISE

The temperature rise of the horizontal and vertical busbars and main bus links including all power draw out contacts when carrying 90% of the rated current along the full run shall in no case exceed 55°C with silver plated joints and 40°C with all other types of joints over the specified ambient temperature. No diversity factor shall be used for temperature rise test.

25.2 DERATING OF EQUIPMENTS

i) The Bidder shall ensure that the equipment offered carry the required load current at specified ambient temperature and perform the operating duties without exceeding the permissible temperature as per relevant code. Continuous current rating at specified ambient temperature shall in no case be less than 90% of the normal rating specified.

ii) The Bidder shall indicate clearly the derating factors, if employed for any component and furnish the basis for arriving at these derating factors duly considering the specified current ratings and ambient temperature specified.

25.3 PROTECTION CO-ORDINATION

It shall be the responsibility of the Bidder to fully co-ordinate the overload and short circuit tripping of the circuit breakers with the upstream and downstream circuit breakers/fuses/motor starters, to provide satisfactory discrimination. Further the various equipment supplied shall meet the requirements of Type C class of Co-ordination as per IEC 292.

26.0 QUALITY ASSURANCE PROGRAMME (QAP)

26.1 All materials, components and equipments covered under this specification shall be procured, manufactured, erected, commissioned and tested as per a comprehensive Quality Assurance Program (QAP) to be approved by the Purchaser. A complete quality plan shall be furnished at the time of submitting the offer.

26.2 The Bidder shall also furnish copies of the reference documents, plant standards, acceptance norms, test and inspection procedure etc. for Purchaser's review or approval. In the approved quality plan, Purchaser shall identify customer hold points, which shall be carried out in the presence of the Purchaser's representative and beyond which work shall not proceed without the consent of Purchaser's representative in writing.

26.3 Purchaser reserves the right to witness any of the tests and verify the documents of the Bidder and his sub-contractor. No materials/equipments shall be dispatched from the manufacturer's works before the same is duly cleared for dispatch by the Purchaser.

26.4 The list of sub-vendors proposed by the Bidder for procurement of major bought out items including raw materials, semi-finished and finished components/equipments, shall be subject to Purchaser's approval.
26.5 The Bidder shall carry out an inspection and testing program during manufacture in his works and that of his sub-vendors to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials, parts and equipments. He shall carry out all tests/inspection required to establish that the items/equipments conform to requirements of the specification and the relevant codes/standards specified in this document, in addition to tests to be carried out as per the QAP.

26.6 Quality audit/surveillance/approval of the results of the test and inspections shall not however, prejudice the right of the Purchaser to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Bidder in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawing etc.

27.0 TESTS AND TEST REPORTS

27.1 Test reports for Type tests of the circuit breakers, panels, change over contactors, auxiliary contactors, relays, instrument transformers, indicating instruments shall be furnished along-with the bid for purchaser’s approval. The type test reports shall cover all applicable tests as per relevant standards & codes.

27.2 The following type tests shall be conducted on the board and it’s components
   i) Short time withstand test
   ii) Duty cycle test of breaker
   iii) Temperature-rise test without any diversity factors
   iv) Degree of protection test

27.3 The report of the type tests shall be issued by a reputed test house like CPRI.
ANNEXURE - A

A) **Module Type AE (Electrically Controlled Circuit Breaker)**
   - One (1) Triple-pole circuit breaker, complete with all accessories and power operated mechanism
   - One (1) Circuit breaker control switch
   - Three (3) Current transformers for metering
   - Three (3) Current transformers for protection
   - One (1) Ammeter
   - One (1) Ammeter selector switch
   - One (1) 'Switchgear'/'Normal' selector switch
   - Three (3) Indicating lamps with resistors and colored lenses
   - Six (6) HRC Control fuses
   - One (1) Lock out relay
   - One (1) Suitable time delayed over current release. Alternatively, over current definite time delay relay with adjustable current setting 150% to 600% of the CT secondary current and adjustable time setting 0.1 Sec to 1 Sec may be offered. The relay shall have a resetting ratio of not less than 90%.
   - One (1) Neutral link
   - One (1) DC isolating switch

B) **Module Type AET (Electrically Controlled Circuit Breaker for Incomer from Transformer)**
   *Similar to module type AE but with following additions :*
   - One (1) Neutral current transformer for earth fault protection
   - One (1) Single pole instantaneous earth fault relay with adjustable current setting of 50%-200% of rated secondary current of neutral CT. The relay shall have a resetting ratio of not less than 80%.

C) **Module Type CD (Two Incoming Supplies)**
   *(Note : Incomers shall be housed in separate drawout modules in different panels. Each of the drawout modules shall be provided with 'Service' position limit switch having 2 NO+2NC contacts).*
   - **Incomer**
     - One (1) Triple pole load break isolating switch
     - One (1) Triple pole contactor with coil
     - Two (2) Auxiliary contactors with coil
     - One (1) Indicating lamp with resistor & colored lens
     - Three (3) HRC control fuses

D) **Module Type CS (AC Control Supply Module)**
   *(Note : Module Type CS shall be of non-drawout type)*
   - Two (2) 440/110 V control transformers
   - Two (2) 110 V auxiliary relays
   - Two (2) Earth links
   - Eight (8) HRC Control fuses
   - Two (2) Selector switches

E) **Module Type E/E1/E2 (Switch Fuse Module)**
   - One (1) Triple pole switch-fuse unit with three pole isolating switch and three/one/two HRC fuses for E/E1/E2 modules, respectively
   - One (1) Neutral link
### Module Type G1 (PT Module with Under Voltage Relay)

- **Two (2)** 440/110 V single phase potential transformers, vee/vee connected, mounted on a common draw-out chassis
- **Four (4)** HRC fuses for PT primary
- **One (1)** Voltmeter (0-500 V for use with 440/110 V PT)
- **One (1)** Four position voltmeter selector switch
- **Two (2)** Single pole instantaneous under voltage relays with continuously variable setting range of 40%-80% of 110 volts.
- **Four (4)** HRC control fuses
- **One (1)** Timer having a delay of 0.5 Sec to 3 Sec on pick up with 2 NO self reset contacts suitable for 220 V DC.

### Module Type H (Isolating Switch Module)

- **One (1)** Triple pole load break isolating switch
- **One (1)** Neutral link

### Module Type K1 (Non Reversible Motor Rated Below 30 KW Controlled from MCC)

- **One (1)** Triple pole fuse switch unit with three pole load break isolating switch and three HRC fuses.
- **One (1)** Triple pole contactor
- **One (1)** Bimetallic thermal overload relay with single phasing preventor
- **Two (2)** Push buttons
- **Three (3)** Indicating lamps with resistors and colored lenses
- **One (1)** HRC control fuse
- **One (1)** Control link

### Module Type K11 (Non reversible Motor Rated 30 KW to 110 KW Controlled from MCC) Similar to module type K1 but with the following additions

- **One (1)** Current transformer for metering
- **One (1)** Ammeter
- **One (1)** Single -pole switch and fuse for motor space heater
J) Module Type K2 (Non Reversible Motor Rated below 30 KW Controlled from Remote Control Panel)

- One (1) Triple pole switch fuse unit with three pole load break isolating switch and three HRC fuses.
- One (1) Triple pole contactor
- One (1) Bimetallic thermal overload relay with single phasing preventor
- Three (3) Indicating lamps with resistors and colored lenses
- One (1) HRC Control fuse
- One (1) Control link
- One (1) 'Normal' / 'Trial' selector switch
- One (1) Auxiliary contactor

K) Module Type DK2 (Non Reversible Motor Rated Below 30 KW Controlled from PLC)
(Similar to module type K2 without 'Normal' / 'Trial' selector switch but with two (2) coupling relays.)

L) Module type K2/DK21 (Non Reversible Motor Rated 30 KW to 110 KW Controlled from Remote Control Panel/PLC)
(Similar to module type K2/DK2 but with the following additions)

- One (1) Current transformer for metering
- One (1) Ammeter
- One (1) Single-pole switch and fuse for motor space heater

M) Module Type K3 (Non Reversible Motor Rated Below 30 KW Controlled Locally)

- One (1) Triple pole fuse switch unit with three pole load break isolating switch and three HRC fuses.
- One (1) Triple pole contactor
- Bimetallic thermal overload relay with single phasing preventor
- Three (3) Indicating lamps with resistors and colored lenses
- One (1) HRC control fuse
- One (1) Control link

N) Module Type K31 (Non Reversible )
Motor 30 KW to 110 KW controlled locally)
(Similar to module type K3 but with the following additions)

- One (1) Current transformer for metering
- One (1) Ammeter
- One (1) Single pole switch and fuse for motor space heater

O) Module Type NI (Reversible Motor Controlled from Remote Panel)

- One (1) Triple pole fuse switch unit with three pole load break isolating switch and three HRC fuses.
- Two (2) Triple pole mechanically interlocked, forward and reverse contactors.
- One (1) Bimetallic thermal over load relay with single phasing preventor.
- One (1) 'Normal' / 'Trial' selector switch.
- One (1) Indicating lamp with resistor and colored lens.
- One (1) HRC control fuse
- One (1) Control link
<table>
<thead>
<tr>
<th></th>
<th><strong>Module Type DN1 (Reversible Motor Controlled from PLC)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>One (1)</td>
<td>Triple pole fuse switch unit with three pole load break isolating switch and three HRC fuses.</td>
</tr>
<tr>
<td>Two (2)</td>
<td>Triple pole mechanically interlocked, forward/reverse contactors.</td>
</tr>
<tr>
<td>One (1)</td>
<td>Bimetallic thermal overload relay with single phasing preventor.</td>
</tr>
<tr>
<td>One (1)</td>
<td>Indicating lamp with resistor and colored lens.</td>
</tr>
<tr>
<td>One (1)</td>
<td>HRC control fuse</td>
</tr>
<tr>
<td>One (1)</td>
<td>Control link</td>
</tr>
<tr>
<td>One (1)</td>
<td>Auxiliary contactor</td>
</tr>
<tr>
<td>Two (2)</td>
<td>Coupling relays</td>
</tr>
</tbody>
</table>
# TECHNICAL INFORMATION

<table>
<thead>
<tr>
<th></th>
<th><strong>Applicable Standard</strong></th>
<th>IS 8623</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td><strong>Enclosure</strong></td>
<td>Single Front</td>
</tr>
<tr>
<td>3</td>
<td><strong>Protection of Enclosure</strong></td>
<td>IP52 for indoor</td>
</tr>
<tr>
<td>4</td>
<td><strong>Location</strong></td>
<td>indoor.</td>
</tr>
<tr>
<td>5</td>
<td><strong>Rated voltage</strong></td>
<td>440 V</td>
</tr>
<tr>
<td>6</td>
<td><strong>Rated control voltage</strong></td>
<td>110 V AC</td>
</tr>
<tr>
<td>7</td>
<td><strong>Bus Bar system</strong></td>
<td>TPN, Aluminium</td>
</tr>
<tr>
<td>8</td>
<td><strong>Bus Bar rating</strong></td>
<td>Horizontal Main Bus 2000 A, Vertical Bus 1000 A</td>
</tr>
<tr>
<td>9</td>
<td><strong>Short time rating</strong></td>
<td>50 kA for 1 Sec</td>
</tr>
<tr>
<td>10</td>
<td><strong>Power frequency withstand voltage</strong></td>
<td>2.5 kV for 1 min for Bus Bars &amp; Breakers, Switches &amp; Contactors, 2 kV for 1 min for Relays, Timers, Transformers</td>
</tr>
<tr>
<td>11</td>
<td><strong>Interrupting capacity of breakers</strong></td>
<td>P1 for MCCB &amp; P2 for ACB</td>
</tr>
<tr>
<td>12</td>
<td><strong>Duty of power contactors</strong></td>
<td>AC 3 for non reversible &amp; AC 4 for reversible</td>
</tr>
<tr>
<td>13</td>
<td><strong>Duty of auxiliary contactors</strong></td>
<td>AC 1</td>
</tr>
<tr>
<td>14</td>
<td><strong>Category of switches</strong></td>
<td>AC 23 for fuse switches &amp; AC 22 for auxiliary devices</td>
</tr>
<tr>
<td>15</td>
<td><strong>Type of HRC fuses</strong></td>
<td>Current limiting</td>
</tr>
<tr>
<td>16</td>
<td><strong>Rating of HRC fuses</strong></td>
<td>50 kA</td>
</tr>
<tr>
<td>17</td>
<td><strong>Type of control transformer</strong></td>
<td>Dry type, 440/240 V of adequate rating</td>
</tr>
<tr>
<td>18</td>
<td><strong>Type of potential transformer</strong></td>
<td>Dry type, 440/110 V of adequate rating</td>
</tr>
<tr>
<td>19</td>
<td><strong>Cabling for power circuits</strong></td>
<td>Cable alley for external cables, Modules for internal cables below 70 Sq mm &amp; in separate cable chamber for 70 Sq mm and above</td>
</tr>
<tr>
<td>20</td>
<td><strong>Cable entry</strong></td>
<td>Bottom/Top</td>
</tr>
<tr>
<td>21</td>
<td><strong>Cabling for control circuits</strong></td>
<td>AC control 1.5 Sq mm, 660 V PVC, Black, Copper, DC control 1.5 Sq mm, 660 V PVC, Green, Copper, CT secondary 2.5 Sq mm 660V PVC, Red, Copper, Earthing 1.5 Sq mm, 660 V PVC, Grey, Copper, Wire indication - Self locking, PVC, Ferrules</td>
</tr>
<tr>
<td>22</td>
<td><strong>Earthing</strong></td>
<td>Main Bus- Aluminium 300 Sq mm and Vertical Bus-150 Sq mm</td>
</tr>
<tr>
<td>23</td>
<td><strong>Dimension of a single panel</strong></td>
<td>As required subject to Purchaser’s approval</td>
</tr>
<tr>
<td>24</td>
<td><strong>Paint &amp; Finish</strong></td>
<td>Panel outer surface- Smoke Grey, Panel inner surface - glossy White</td>
</tr>
<tr>
<td></td>
<td>Module description</td>
<td>Requirement of PLC</td>
</tr>
<tr>
<td>---</td>
<td>-------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>25</td>
<td>Chassis- Zinc passivated Command module-Aluminium anodised Name plate-Non rusting material Lettering- White non graved on black back ground</td>
<td>Refer drawing enclosed</td>
</tr>
<tr>
<td>26</td>
<td>Requirement of PLC</td>
<td>As required</td>
</tr>
<tr>
<td>27</td>
<td>Requirement of Control Panel for Remote operation</td>
<td>As required</td>
</tr>
<tr>
<td>28</td>
<td>Requirement of Local Control Station for Local &amp; Remote operation</td>
<td>As required</td>
</tr>
<tr>
<td>29</td>
<td>Requirement of Local operation only</td>
<td>As required</td>
</tr>
</tbody>
</table>
GENERAL SPECIFICATION FOR COMPONENT OF EQUIPMENT OF
THE MICRO-PROCESSOR BASED CONTROL SYSTEM (PLC )

1.0 OPERATION OF MICRO-PROCESSOR BASED PLANT
MONITORING AND CONTROL SYSTEM

The micro-processor based control system for sequencing operation shall be
provided for monitoring and control of proposed CHP. The system shall
comprise the following:

i) Programmable logic controller based on micro-processor
technology
ii) Input/Output racks
iii) Compatible system with color monitor and standard key board
iv) Modem for communication with remote PC
v) Necessary pre-fabricated inter-connecting cables

The system shall be micro-processor based system that can be used
as a direct replacement for relay system and other hardwired systems.
The programming shall be in the form of Relay Ladder Diagram which
uses standard relay diagram symbols. With this facility menu defined
key strokes on standard key boards shall be used to draw ladder
diagrams which can be down loaded into the processor memory.

The user programme in the memory shall be sequentially scanned, the
status of inputs and outputs shall be tested and appropriate action shall
be initiated. Having examined the status of the inputs and/or outputs,
the processor shall be capable of energizing or de-energizing outputs
and catches, performing counting and timing functions doing data
comparison and transfers.

For centralised monitoring and control, the existing CHP has been
divided into three zones as under:

ZONE A (Receiving zone):
It covers all equipment like crusher coal sizer, electric crane, apron
feeder, hydraulic rock breaker, grab attachment, belt conveyor
BC1, magnetic separator, metal detector etc.

ZONE B (Reclaim zone)
It covers all the equipment like belt conveyor BC3 & BC4, tripper
conveyor BC2, trippers, dust suppressor, belt weigher, pump house, fire
fighting, electric crane etc.

ZONE C (Silo zone)
It covers all equipment in silo loading complex including sampling
system, electric crane, fire fighting system etc.

All the equipment in zone A & zone B will be controlled from a control desk
located at central control room (CCR-1) on the first floor of 6.6kV switching
station

All the equipment of rapid loading system including level indicator of silo will
be controlled from a control desk located in control room in the silo complex
The control systems envisaged in Zone A & B will only be restricted for operation of equipment locally for testing and maintenance purpose. The sequence operation of the entire plant starting from primary crushers up-to level indicators installed in silo shall be done from a central control console located in control room-I at first floor of 6.6kV switching station. The status of individual equipment of Zone C shall also be available at this central control console. However status of individual equipment of that particular zone along-with fault annunciation system shall also be made available in the control room of respective zones.

The Control Desk cum mimic panel at Central Control Room I shall have operator console with functional key-board with VDU for mimic display and annunciation. Apart from this, Central Control Room I shall have VDU with facilities for composite mimic display. The communication equipment shall also be housed in the control Room. From a functional Key-board of the control room, all the related equipment shall be remotely started or stopped in sequential manner and the coal flow of all equipment shall be displayed in the respective mimic display. The respective annunciation shall indicate the status of different equipment and conveyor health monitoring parameters.

The control system for zone B shall have the facility for:

a) Sequence and interlocking operation of control zones A, B & C.
b) Composite Mimic display of equipment of control Zones A, B & C on Color VDU through operator interface
c) Fault Annunciation of equipment of control Zones A, B & C on same VDU
d) In addition to above, the status display of control Zone B shall also be displayed on a VDU.

The control system for zone A & B shall have the facility for:

a) Local operation of equipment of respective control zones.
b) Mimic display of equipment of respective control Zones on Color VDU
c) Fault Annunciation of equipment of respective control Zones on same VDU

The control system for zone C shall have the facility for:

a) Sequence and interlocking operation of control zone C including dove-trailing arrangement with reclaim conveyors and control system for rapid loading system.
b) Mimic display of equipment of control Zone C on Color VDU
c) Fault Annunciation of equipment of control Zone C on same VDU

For communication between PLCs for different control Zones, a data link wire transmission mode with suitable MODEM at either end shall be provided.

One number printer shall be provided at Control Rooms for providing hard copies of management information reports like hourly logs, shift logs, daily logs etc.

Individual Audio Visual units (AVU) should be installed in MCC rooms, bunker and all other strategic locations for the purpose of composite mimic display of the entire plant along with audio signaling.
2.0 MICRO-PROCESSOR CONTROLLER

The system shall have one or more micro-processor controller for inter-acting with the starter panels of the drives with or without inter posing relays. These controllers shall also interact with various control instrumentation provided for monitoring of drives and shall basically consist of a regulated power supply unit and plug-in type cords for easy maintenance. The controller shall comprise a central processing unit, solid state memory, digital input modules with optical isolation with potential free contracts, digital output modules for generation of control output. The micro-processor memory shall contain software which shall achieve all logical processing by executing instructions in the CPU. The controller hardware shall be modular in construction so that future additions or alternations in the plant can be easily carried out at a nominal cost.

3.0 V.D.U

Single or dual VDU shall have to be provided with micro-processor controller for displaying mimics, alarms, plant status etc. A variety of mimics shall have to be provided so as to ensure enhanced and clear visibility of the plant. The mimics shall have separate color codes for healthy and faulty drives, local and remote drives etc. Besides mimics, the VDU shall be capable of showing various alarms and warning messages sequentially indicating the time of occurrence, name of faulty drive and the type of the fault. The messages should come in such a way so as to enable fast fault diagnosis which shall reduce the downtime of the drive. The alarms of critical nature shall have to be indicated to catch the immediate attention of the operator. The status of various plant drives shall have also to be shown on the VDU as described earlier.

4.0 FUNCTIONAL KEY BOARD

Necessary functional keyboard shall have to be provided as an operator interface with the plant. The operator shall be able to key in various plant commands, provide individual start/stop, sequential start/stop, block start/stop, acknowledge alarms etc. The operator shall also be able to call up various display of the VDU as desired by him. The operator shall be in absolute command of the plant.

5.0 PRINTER

A printer shall have to be there to provide a hard-copy of various displays and logging reports for management reporting. Various logs e.g. hourly logs, shift logs and demand logs shall have to be provided.

6.0 SOFTWARE

The micro-processor plant monitoring and control system shall have to be based on easily reconfigurable software. Various sequencing inter-locks and timing functions shall have to be provided with the help of the software. The software shall be flexible and easily expandable in case of future additions/alterations in the plant. It shall be operator friendly and easy to understand.
7.0 **LOCAL CONTROL STATION**

The inter-locking and selector switch, start stop push buttons and indication lamp on the local control station shall be mounted on the front face of the enclosure. They shall be so disposed that operation is convenient. The local control stations shall be pedestal/wall mounted.

8.0 **SELECTOR SWITCH**

All the selector switches shall be dust proof and oil tight, rotary switches with pistol handle operating facility. The rating of contact shall be minimum 10 amps at 230 Volts. The switches shall conform to IS : 2628 (latest).

9.0 **START – STOP PUSH BUTTONS**

Push buttons shall be dust and oil tight and the face of the button shall be flushed with the retaining ring. ‘Start’ buttons should be green and stop buttons should be red in color.

10.0 **INDICATING LAMP:**

The indicating lamps shall be preferably miniature, filament type with caps of colored translucent lenses. The lamp on the local control station shall be so fitted that it is removable from the front of the unit without disturbing the internal wiring and the holder. The indicating lamps shall conform to IS : 1901(Latest).

11.0 **EMERGENCY STOP PUSH BUTTON**

All hand operated emergency stop push buttons shall have mushroom type head, Red in color with manual resetting facility. Emergency stop switches shall be dust and oil tight with necessary NO and NC contacts rated for 10 Amps. at 230 Volts A.C.

12.0 **LEGEND PLATE**

The legend plates shall be provided to identify the rating and function or operation of all control components/indications. All the legend plates shall be of block anodized aluminium with text engraved thereon.

13.0 **CONTINUOUS LEVEL MONITOR**

The continuous level monitor shall be dust and water tight and suitable for continuous monitoring of level of coal in the Rock Box/Bunker/Silo. The sensor units shall be suitable for mounting on the conveyor gantry structure. The system shall be either ultrasonic type or can be based on advanced micro-wave circuitry and micro processor technology. The system shall ensure high reliability and have local and remote display facilities indicating average level and quantity of coal in the bunker at any instant.

14.0 **UPS SYSTEM AND BACK-UP ARRANGEMENT**:

UPS system of required capacity shall have to be provided, with suitable batteries for 30 minutes back-up arrangement. The UPS system shall be ‘ON-LINE’ system which shall ensure that there is no break in the power supply to the PLC based control system.

In the event of loss of power supply it will be able to maintain the status record of various equipment of plant control system on un-interruptible power supply having capacity to feed the load of PLC system for duration of ½ hour during which the power supply is restored.
15.0 SCREENED INSTRUMENTATION/SIGNAL CABLE

Conductor
Electrolytic grade tinned annealed copper conductor, 7 stranded with each strand of 0.5 mm dia. for 1.5 sq. mm conductor.

Insulation
85° C PVC conforming to Type C: IS:5381 (latest) with minimum insulation thickness of 0.5 mm.

Core Laying
Insulated cores twisted together to form pair/triad/quad with a lay of twist as 16 to 18 twists per meter.

Shield
a) Individual shield shall consist of aluminium backed mylar tape, helically applied with either side 30% overlap, 100% coverage, Min. shield thickness shall be 0.05 mm.

b) Overall shield shall consist of aluminium backed mylar tape, helically applied with either side 30% overlap, 100% coverage. Min. shield thickness shall be 0.075 mm.

Drain Wire
The drain wire for both, the individual and overall shielding shall be 1 mm dia bare tinned annealed copper wire continuously contacting aluminium side of mylar tape.

Inner Jacket
Extruded, 70° C PVC coating conforming to type ST 1 of IS 5831 (latest) with minimum jacket thickness of 0.6 mm

Armour
Served type made of G.I. wire of 1.0 mm dia/1.4 mm dia

Outer Jacket
70° C PVC conforming to Type ST 1 of IS : 5831 (latest) with nominal jacket thickness of 2 mm.
SPECIFICATION FOR CONTROL PANELS FOR PLC & OTHER SYSTEM REQUIREMENT

1.0 SCOPE

This covers requirements for Control Panel for PLC and other system requirement in accordance with IS 8623.

2.0 STANDARDS CODES & RULES

2.1 The equipment shall be designed in accordance with the provisions of the following standards, codes and rules:

- IS :13947 LV switch gear and control gear
- IS : 4064 Air Break Switches, air break disconnectors and fuse combination for voltages not exceeding 1000 V AC
- IS :8828 Miniature Circuit Breakers for voltages not exceeding 1000 V AC
- IS :6875 Switches and push-buttons
- IS :13703 LV fuses for voltages not exceeding 1000 V AC
- IS :8828 Guide for uniform system of marking and identification of conductors and apparatus terminals
- IS :2147 Degree of protection provided by enclosures for low voltage switchgear and Control gear
- IS :3043 Code of practice for earthing
- IS :6005 Code of practice of phosphating iron and steel
- IS :1248 Electrical Indicating instruments
- IS : 2419 Panel mounted indicating and recording electrical instruments dimension
- IS :1554 PVC insulated(Heavy Duty) cables for working voltages up to and including 1100V
- IS :694 PVC insulated cables for working voltages up to and including 1100V
- IEC-65 A Programmable controllers
- IS :5 Colours for ready-mixed paints and enamels
- IE Rules 1956

2.2 Equipment complying with any other authoritative/internationally recognised standards such as IEC, BS, VDE etc. shall also be considered if it ensures performance equivalent or superior to Indian Standards. In such cases the bidder shall clearly indicate the standard adopted and furnish the copy of latest English version of the same along with the bid and bring out the salient features for comparison.

2.3 The standards specifications and codes of practice referred to herein shall be the latest edition including all applicable official amendments and revisions as published one month prior to the date of opening of bids. In case of conflict between this specification and those (IS Codes, Standards etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following codes and standards.
3.0 SERVICE CONDITION

Ambient Conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient air temperature</td>
<td>50°C (-) 5°C to (+) 50°C</td>
</tr>
<tr>
<td>Altitude</td>
<td>Maximum upto 1000 M above MSL.</td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>Approximately 97%</td>
</tr>
<tr>
<td>Pollution degree</td>
<td>Degree 4 as per IS : 13947 (Part I) (i.e. the pollution generates persistent conductivity caused by conductive dust)</td>
</tr>
</tbody>
</table>

Operating Conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal system</td>
<td>415 V (+/- 10%)</td>
</tr>
<tr>
<td>Supply Frequency</td>
<td>50 Hz (-5% to +3%)</td>
</tr>
<tr>
<td>System earthing</td>
<td>Effectively earthed</td>
</tr>
<tr>
<td>Highest Fault Level</td>
<td>10 MVA</td>
</tr>
</tbody>
</table>

4.0 DESIGN & CONSTRUCTION

4.1 Design

The equipment shall be designed to ensure the following:

(i) Capacity to withstand fault level mentioned above

(ii) Capacity to withstand power frequency voltage mentioned in annexure I

(iii) Continuous operation at rated capacity at service condition mentioned above

(iv) Ready interchangeability of components of equipments with identical specification

(v) The bidder shall prepare electrical drawings for each module of the equipment for purchaser's approval

4.2 Construction

4.2.1 The panel frame shall be fabricated using suitable mild steel sections of pressed and shaped, cold-rolled sheet steel of thickness not less than 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary. Gland plates shall be of removable type and at least two separate gland plates shall be provided for each panel. They shall be of sheet steel of thickness not less than 3.0 mm. All hardware used shall be Ni-Chromium plated.

4.2.2 All panel and cover/door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members. There shall be no sharp edges or corners.

4.2.3 The complete structure shall be rigid, self supporting, freeform flaws, twists and dents. All cut outs shall be true in shape and devoid of sharp edges.

4.2.4 The panels shall be assembled on channel/angle base frames.
4.2.5 The standing type panels shall be provided with hinged doors of width not exceeding 600 mm (with in built locked arrangement and handle). It shall be possible to open the door through 100 degree. The doors, cut-outs and covers shall be equipped with approved type of synthetic/rubber all round and sufficient number of latches/bolts shall be provided to achieve a degree of protection of IP.52 as per IS : 2147. However, degree of protection of panels located in dusty atmosphere shall be IP : 62.

4.2.6 The height of all control devices on the panels shall be between 700 mm and 1600 mm from the finished floor level. Operational convenience and aesthetic appearance shall be prime consideration in finalisation of the panel general arrangement (front view). The maximum height of the panels shall not exceed 2300 mm.

4.2.7 All equipment mounted on the front face of the panels shall be flush or semi-flush type. All equipment shall be so located that their terminals and adjustment knobs are readily accessible for inspection and maintenance and their removal and replacement can be done without disturbing the other equipment.

4.2.8 All internal components of the panels shall also be arranged neatly. Sufficient clearances shall be maintained between different components for ease of maintenance. Detailed internal arrangement drawing of the control panel indicating spacing between different components shall be submitted for Purchaser's approval.

4.2.9 For PLC controlled systems, the control panel shall have control desk type of configuration. The desk shall have doors at the back.

4.2.10 The equipment on desk shall be mounted such that removal and replacement can be done individually without any interruption of services to adjacent devices. The equipment mounted inside the desk like power supply, switches, fuses etc. shall be so located that terminals and adjacent devices are readily accessible without the use of special tools.

4.2.11 The control desk shall have one vertical bench surface and one horizontal bench surface at the front. On the vertical bench all meters, indicators, control CRT etc. shall be mounted. On inclined horizontal bench, key boards, electrical switches, push buttons, indicating lamps and selector switches shall be mounted. The annunciation windows shall be provided on the vertical plane of the control desk.

4.2.12 The PLC panel shall be free standing vertical type separate from control desk. The equipment shall be rack mounted and arranged in clearly defined sections for I/O devices, processors, power supplies etc. About 20% space shall be left for future expansion in each section. A cable marshalling section shall be included. Density of the electronic component inside the panel shall be such that the maximum temperature rise of component is limited within 10°C above the ambient temperature. The components shall be free from false operation due to vibrations and mechanical shocks.

4.2.13 The PLC panels shall be provided with perspex/glass doors in front to facilitate monitoring of the LED indication of various cards mounted in the card rack.

4.2.14 The circuits shall be of modular design using electronic printed plug in card circuits. Electronic components and cards shall be suitable for satisfactory operation in non air conditioned environment.

4.2.15 All components shall be clearly and unambiguously marked for proper identification and easy maintenance. The wires shall be colour coded. Readily accessible and clearly marked test points shall be provided in all important modules and circuits.
4.2.16 I/O racks and processor cabinets shall be provided with door switches which shall provide proper annunciation on control desk in case doors are open.

4.2.17 Wherever a number of panels have to be mounted side by side, they shall be bolted together to form a compact unit. Their joints shall be smooth, close fitting and provided with neoprene/Synthetic gaskets of approved quality.

4.2.18 Removable eye bolt or lifting lugs shall be provided on all panels to facilitate easy handling.

4.2.19 The Bidder shall ensure that the control panels are vermin proof, and all surplus holes in the gland plates shall be tightly closed by rubber plugs.

4.2.20 **Control and selector switches**

4.2.20.1 Control and selector switches shall be of rotary type with escutcheon plates clearly marked to show the function and positions. The switches shall be of sturdy construction suitable for mounting on panel front. Switches with shrouding of live parts and sealing of contacts against ingress of dust shall be preferred.

4.2.20.2 Control/Selector switches shall be spring return or stay put type as per the requirements. Lost motion feature shall be provided wherever required. Handles of control/selector switches shall be black in colour. Shape and type of handles shall be subject to approval of the Purchaser.

4.2.20.3 Ammeter and voltmeter selector switches shall have four stay-put positions with adequate number of contacts for three phase 4-wire system. These shall have oval handles. Ammeter selector switches shall have make before break type contacts to prevent open circuiting of CT secondary.

4.2.20.4 Contacts of the switches shall be spring assisted and shall be of suitable material to give a long, trouble free service.

4.2.20.5 The contact ratings shall be at least the following:
   i) Make and carry continuously - 6 Amp.
   ii) Breaking current at 220 V DC - 0.5A (Inductive)
   iii) Breaking current at 240 V AC - 5A at 0.3 p.f. lagging

4.2.21 **Push buttons**

4.2.21.1 Push buttons shall be spring return, push to actuate type and rated to make, continuously carry and break 6A at 240 V AC and 0.5 A (Inductive) at 220 V DC. The push buttons shall have at least 1 NO and 1 NC contacts. All contact faces shall be of silver or silver alloy.

4.2.21.2 Every push button shall be provided with integral escutcheon plate marked with its function.
   The colour of push buttons shall be as follows:
   - GREEN - for motor START breaker CLOSE,
   - RED - for motor TRIP, breaker OPEN,
   - BLACK - for all annunciator functions, overload reset and miscellaneous Red push-buttons shall always be located to the left of green push-buttons.

4.2.22 **Indicating lamps**

4.2.22.1 Indicating lamps shall be of the panel mounting, filament type, low wattage and capable of clear status indication to operator under the normal room
illumination. Lamps shall be provided with non-hygroscopic series resistors, preferably built in the lamp assembly. The lamps shall have escutcheon plates marked with their functions, wherever necessary.

4.2.22.2 Lamps shall have translucent covers of the following colours:
- RED - for motor ON, breaker OPEN /CLOSED
- GREEN - for motor OFF, breaker OPEN
- WHITE - for breaker TRIP
- BLUE - for all HEALTHY conditions (e.g. control supply, lube oil pressure)
- AMBER - for all ALARM conditions

4.2.22.3 Bulbs and lamp covers shall be easily replaceable from front of the panel

4.2.22.4 Indicating lamps shall be located directly above the associated push buttons/ control switches. Red lamps shall be located to the right of green lamps. In case a white lamp is also provided, it shall be placed between the red and green lamps. Blue and Amber lamps shall normally be located above the Red and Green lamps.

4.2.22.5 All indicating lamps shall be suitable for continuous operation at 90% to 110% of their respective nominal control supply voltage, i.e. 220 V DC or 240 V AC.

4.2.23 Indicating instruments

4.2.23.1 All indicating and integrating meters shall be flush mounted on panel front. The instruments shall be of miniaturised type with 90 scales and shall have an accuracy class of 2.0 or better. These shall be suitable for measurement of current ranging from 4 to 20 mA for incoming feeder only. The covers and cases of instruments and meters shall provide a dust and vermin proof construction.

4.2.23.2 All instruments shall be compensated for temperature errors and factory calibrated to directly read the primary values.

4.2.23.3 Ammeters shall be provided for all motors rated 30 KW and above. These shall have a compressed scale at the upper current region to cover the starting current. They shall be suitable to withstand, five times CT Secondary current for 30 secs.

4.2.24 Name plates and labels

4.2.24.1 Each panel shall be provided with prominent, engraved identification plates for all front mounted equipment. Panel identification name plates shall be provided at front and rear.

4.2.24.2 All name plates shall be of non-rusting metal with white engraved lettering on black background. Inscription and lettering sizes shall be subject to Purchaser’s approval.

4.2.24.3 For easy identification of all equipment inside the panel, they shall be marked with suitable, clear, indelible paint markings. Use of stickers for identification, is not preferred. Labels for fuses shall also clearly indicate current ratings of the respective fuses. These labels shall be so positioned as to be clearly visible and note the device number.
4.2.25 **Mimic diagram**

4.2.25.1 Mimic diagram of the mechanical/electrical system shall be furnished on the panel front as per requirement.

4.2.25.2 Mimic lines (flow lines) shall be at least seven (7) mm in width. Mimic plate shall be polyester based fibre laminated of about 4 mm thickness. Various equipment shall be depicted with screen painting. Mimic plate sample shall be submitted for Purchaser's approval before fabrication. Luminous lamp indications for status/position shall be provided on the mimic for all equipment.

4.2.25.3 The mimic representation, color and size of diagram are subject to the approval of Purchaser.

4.2.26 **Air break switches**

4.2.26.1 Air break switches shall be of heavy duty, single throw, load break, complying with relevant code. The Bidder shall ensure that all switches are adequately rated so as to be fully matching with the associated fuses.

4.2.26.2 Power supply switch operating handles shall be provided with padlocking facilities to lock them in 'OFF' position.

4.2.26.3 All switch fuse units shall be provided with removable type neutral link. The link shall be suitably rated, matching with switch rating.

4.2.27 **Fuses**

4.2.27.1 All fuses shall be of HRC cartridge fuse link type, and suitable rating, depending upon circuit requirements. They shall be mounted on fuse carriers, which in turn shall be inserted in fuse bases.

4.2.27.2 All DC circuits shall be fused on both poles. AC circuits shall have fuses on phase side and link on neutral side.

4.2.27.3 All fuses shall have visible operation indicator.

4.2.28 **Contactors**

4.2.28.1 Auxiliary Contactor shall be of air break, electro-magnetic type and shall be of 6 A, 240 V AC, AC 11 utilisation category. Contacts shall have a rated standard thermal current of at least 10 A. The contacts shall also have a 220 V, DC 11 utilisation, category rating of at least 0.5 A. The contactor shall have a rated make/break life of at least one million operations.

4.2.28.2 Contactors shall have contacts as required for control schemes. Contacts shall be silver faced.

4.2.29 **Relays and timers**

4.2.29.1 All protective relays, auxiliary relays and timers shall be of proven design and of reputed make. Contacts of relays and timers shall be of silver or silver cadmium oxide or silver faced. Timers shall have the provision to adjust the delay on pick-up or reset as required.

4.2.29.2 Relays and timers shall have the necessary NO/NC contacts, as per scheme requirement.
4.2.30  **Terminal blocks**

4.2.30.1 Terminal blocks shall be of 650 Volts grade, rated for 10 Amps and in one piece moulding. They shall be complete with insulating barriers, clip-on-type and identification strips. Marking or labels on terminal blocks shall correspond to their identification on wiring diagrams.

4.2.30.2 Terminal blocks for CT and VT secondary leads shall be provided with test link and isolating facilities. Terminals for CT secondary leads shall also be provided with short circuiting earthing facilities.

4.2.30.3 All terminal blocks, on which external cables are connected shall be suitable for terminating at least 2 nos. of 1.5 sq.mm of stranded copper wire. Not more than two (2) wires shall be connected to any terminal.

All terminals shall be numbered for identification and grouped according to the function. Terminal blocks shall be properly arranged to facilitate easy termination of cables. They shall have minimum clearances of 200 mm to cable gland plates, and of 150 mm to adjacent terminal rows, panel sides and other equipment.

4.2.30.6 Twenty (20) percent spare terminals shall be provided, distributed over all terminal blocks.

4.2.31  **Wiring**

4.2.31.1 All inter panel wiring and connections between adjacent panels including all bus wiring for AC and DC supplies, shall be provided by the Bidder.

4.2.31.2 All internal wiring shall be carried out with 650 V grade single core, 1.5 square mm or larger, stranded copper wires having colour - coded, PVC insulation. Space heater circuits shall have wires having adequate current carrying capacity, but not less than 2.5 Sq.mm Copper. Internal wiring between electronic cards shall be as per the standard practice of manufacturer.

4.2.31.3 Extra-flexible wires shall be used for wiring to devices mounted on moving parts such as doors. Suitable guards and grommets shall be provided for the wiring wherever it may get damaged in their absence.

4.2.31.4 All wiring shall be properly supported, neatly arranged, readily accessible and securely connected to equipment terminals and terminal blocks.

4.2.31.5 Engraved core identification ferrules marked to correspond with panel wiring diagrams, shall be fitted at both ends of each wire. Jumper wires between two terminal blocks shall also be ferruled at both ends.

4.2.31.6 The ferrule numbers shall identify the equipment terminals to which a wire is connected or may be based on the standard practice of the panel manufacturer. The exact ferruling arrangement shall be subject to Purchaser's approval.

4.2.31.7 Spare contacts of relays, timers and switches shall be wired out to the panel terminal blocks only as required by the Purchaser, during approval stage.

4.2.31.8 The panels shall have separate wire ways for internal wiring of the panels, distinct and physically separate from wire ways for external cablings.

4.2.31.9 Internal wiring of the panels shall preferably be done to facilitate termination of
the external multi core control cable of the adjacent terminals of the same terminal block.

4.2.31.10 Suitable clamping facility for external cables shall be provided in the panels.

4.2.32 Earthing

4.2.32.1 A continuous copper earthing bus of 25mmx3mm size shall be provided along the bottom of the panel structure. It shall run continuously through out the length of the panel and shall have provision at both ends for connection to the station earthing grid. Wherever termination of shielded cables is envisaged, provision for termination of cable shields shall be made.

4.2.32.2 Metallic parts of all components shall be effectively earthed using green coloured insulated copper wire or other approved means. However, earthing through effective connection with the metallic control panel surface by approved type of washers shall also be acceptable. Electrical continuity of the whole enclosure/frame work shall be maintained even after painting. All hinged doors shall be earthed through flexible earthing braids of copper.

4.2.32.3 Earthing of electronic circuits shall be looped between cabinets, I/O racks and shall be earthed at one point of PLC panel. The common earth point shall be connected to station earth mat on a separate riser.

4.2.33 Space heater and lighting

4.2.33.1 Space heaters shall be provided in the panels wherever the manufacturer considers necessary and recommends their provision for preventing harmful moisture condensation.

4.2.33.2 The space heaters shall be suitable for continuous operation on 240 V AC single phase supply and shall be automatically controlled by thermostat. Each free standing control panel section shall have a 240 V AC, plug point and a fluorescent light operated by door switch.

4.2.33.3 Necessary isolating switches and fuses shall also be provided.

4.2.34 Control and power supply scheme

4.2.34.1 One feeder of 440 V AC shall be drawn by the Bidder from each of MCC. The Bidder shall provide isolating switch fuse unit for receiving this supply. Two numbers of 440/110 V single phase dry type transformers shall be provided in control panel for A.C. control supply. These transformers shall be adequately sized to meet power requirements of auxiliary relays, indicating lamps & other auxiliary instruments. One pole of the secondary of these transformers shall be solidly earthed through link. A manual or automatic change-over arrangement (depending on requirement) shall be provided on secondary side of transformers.

4.2.34.2 The Bidder shall ensure proper discrimination in the fuses provided for different circuits, grouping of which shall be to Purchaser's approval.

4.2.34.3 The control schemes shall be so designed that failure of control supply or an auxiliary relay do not initiate an unintended opening or closing of breakers to the extent possible.

4.2.34.4 For the PLC panel the power supply shall be tapped from the control panel. Necessary transformer/power packs shall be provided by the Bidder. The equipment power supply unit shall be mounted as an integral part of the enclosure and provide all voltages necessary to power the central processor and I/O cabinets. For separately mounted I/O racks separate power supplies
shall be provided. Power supply module shall be of ample capacity to supply all modules. Additionally, about 20% spare capacity for future use shall be provided.

4.2.34.5 The components shall be suitable for the supply voltage variation of $\pm 10\%$ of the rated voltage and suitable for withstanding a momentary supply voltage rise upto 70% for about 10 secs. above the nominal system voltage. Necessary constant voltage transformers or voltage stabilisers shall be provided by the Bidder if required.

4.2.35 **Annunciation system**

4.2.35.1 The annunciation system shall be complete with all necessary relays, flashers and other accessories required for the proper operation of the equipment. Audible alarms for the system shall be mounted inside the control panel. One set of acknowledge, reset and test push buttons shall be mounted on control panel.

4.2.35.2 Indications shall be engraved on translucent glass or plastic windows and shall be visible clearly when the indication lamp starts glowing (black letters on white background). Each window shall be provided with two lamps.

4.2.35.3 Audible horn shall sound when a trouble contact operates and shall continue to sound until the acknowledge button is pressed.

4.2.35.4 Indication lamps shall flash when alarm circuit contact operates and shall continue flashing until acknowledge button is pressed.

4.2.35.5 After acknowledge button is pressed, the horn and flashing shall stop but the indication lamp shall continue to glow.

4.2.35.6 After the fault is cleared and reset button is pressed the lamp shall go off.

4.2.35.7 When test button is pressed, all lamps shall glow and horns shall gong.

4.2.35.8 Annunciation system shall operate on nominal 220 V DC system.

4.2.35.9 The annunciation system shall include alarms for control supply failure and DC failure (working on AC supply) and testing facilities for these alarms.

4.2.35.10 If solid state annunciation circuit is used, the necessary electrical isolation shall be provided between the field wiring and electronic circuitry, to prevent spurious operation due to external disturbances. It shall also ensure that the hooter operation does not cause any interference with the electronic circuitry.

4.2.36 **PAINTING**

All sheet steel work shall be pre-treated in tanks in accordance with IS: 6005. The phosphated surfaces shall be rinsed and passivated, given a stoved lead oxide primer coating, followed by the coats of finishing synthetic enamel paint. Each coat of primary and finishing paint shall be of slightly different shade to enable inspection of painting. Finishing paint on panels exterior shall be shade 692 (smoke grey) of relevant code. The inner surface of the panels shall be glossy white. Each coat of finishing shall be properly stoved. The paint thickness shall not be less than 50 micron. Finished parts shall be coated by peelable compound by spraying method to protect the finished surface from scratches, grease, dirt and oily spots during testing, transportation, handling and erection. Electrostatic painting shall also be acceptable, in which case
same shade for inside and outside may be offered.

5.0 **Technical requirements of programmable logic controller**:

5.1.1 The PLC shall be of modular construction and it shall be possible to change any module without disconnection of any wire.

5.1.2 The PLC system shall be capable of operating in automatic and/or manual control mode with commands from VDU control console and/or from a separate control desk. The specific requirements of controls function shall be discussed.

5.2 **PLC processor**

5.2.1 The processor unit shall be capable of executing the following functions:

a) Receiving binary and analog signals from the field and operator intimated command from the control panels.

b) Implementing all logic functions for control & protection of the equipment and system

c) Issuing control commands

d) Providing alarm and status information.

e) Performing self monitoring and diagnostic functions

f) Providing log output

5.2.2 The controller shall provide all basic functions for binary gating operations, storage, counting, timing, logging and transfer operations and comparison functions. Full details of the number and type of functions and expansion capability shall be submitted with the bid. The programmable system shall be delivered completely programmed for the complete and reliable operation of the MCC.

5.2.3 The PLC unit shall be provided with two processors (Main processing unit and memories) one for normal operation and one as standby. In case of failure of working processor there shall be an appropriate alarm. In the event of both failing, the system shall revert to fail safe mode. It shall be possible to keep any of the processor as master and other as standby.

5.2.4 The memory shall be field expandable. The memory capacity shall be sufficient for the complete system operation with provision for at least 20% expansion in future. Programmed operating sequences and criteria shall be stored in non volatile semiconductor memories like EEPROM. All dynamic memories shall be provided with buffer battery back up which shall be for at least 360 Hours. The batteries shall be lithium or Ni-Cd type.

5.2.5 The PLC system shall be provided with necessary hard-ware for inter connection with Purchaser's/Other Contractor's data high-waty, if required in future.

5.2.6 Programming unit shall have access to the process or of the control system for programming. It shall incorporate an IBM compatible CRT to enable the user to write a programme expressing a set of control instructions and enter them directly by a key board clearly marked with the standard symbols. Programming shall not require special computer skills. On this console, it shall be possible to do the programming, self diagnostics, testing of sequence, simulation and any sequence modification.

5.2.7 Programming shall be possible in any of the following formats:

- Flow chart or block logic representing the instructions graphically
- Ladder diagrams

A forcing facility shall be provided for changing the states of inputs and outputs, timers and flags to facilitate fault finding and other testing.
requirements. It shall be possible to display the signal flow during operation of the programme. Programming shall be possible OFF line.

5.2.8 A NORMAL/TEST/PROGRAMME/OFF lockable selector switch shall be provided on the control panel or processor. In case of test mode of operation, all outputs should be blocked.

5.2.9 Provision shall be made for erasing and duplicating the user programme and long storage facilities shall be provided with the help of cartridge type of EEPROM & not by audio tapes.

5.2.10 Priority of different commands shall be as follows:
- Manual intervention shall be possible at any stage of operation. Protection commands shall have priority over manual commands and manual commands shall prevail over auto commands.

5.2.11 The memory modules shall not be affected by the operation of fluorescent or any other discharge lamps provided for illumination.

5.2.12 INPUT/OUTPUT:
The PLC system should be designed according to the location of the input/output cabinets.

5.2.12.1 Electrical isolation of 1.5 KV with optical couplers between the plant input/output and controller shall be provided on the I/O cards. The isolation shall ensure that any inadvertent voltage or voltage spikes shall not damage or mall operate the internal processing equipment.

5.2.12.2 The Input/Output system shall facilitate modular expansion in fixed stages. The individual input/output cards shall incorporate indications on the module front panels for displaying individual signal status.

5.2.12.3 Individually output circuits with fuse blow indicator shall be provided. All input/output points shall be provided with status indicator. Input circuits shall be provided with fuses preferably for each input, alternatively, suitable combination of inputs shall be done and provided with fuses such that for any fault, fuse failure shall affect the particular drive system without affecting other systems.

All input/output cards shall have quick disconnect terminations allowing for card replacement without disconnection of external wiring. The Bidder shall provide the following monitoring features:
- a) Power supply monitoring
- b) Contact bounce filtering
- c) Optical isolation between input and output signals with the internal circuits
- d) In case of power supply failure or hardware fault the critical outputs shall be automatically switched to the fail safe mode. The fail safe mode shall be decided during approval stage.

5.2.13.2 Keying in of individual wire connector shall be provided to ensure that only the correct card is plugged on the I/O module. It shall be possible to remove I/O module without disconnecting wiring from field inputs or outputs. There shall be at least 20% spare capacity available on input, output and memory modules, over and above the system requirement.

5.2.13.3 Coupling relays provided in the MCC shall have voltage rating as specified. Necessary transducer for interfacing between Purchaser's current transformers and Bidder's supplied miniatureised ammeters on the console shall be supplied and installed by the Bidder. The current transformer rating shall be decided during the approval stage. The remote ammeter supplied by the Bidder shall have input of 4 to 20 mA.
5.2.13.4 Output module shall be capable of switching ON/OFF inductive loads like solenoid valves, auxiliary relays etc. without any extra hardware.

5.2.13.5 Only one changeover contact shall be provided in MCC for control and interlock requirement. Further, multiplication if required shall be done in PLC.

5.2.13.6 All input field interrogation voltage shall preferably be DC only.

5.2.13.7 In case of loss of remote I/O communication link with the main processing unit, the remote I/O shall be able to go to pre-determined fail safe mode with proper annunciation. This shall be decided in approval stage.

5.2.14 **PRINTER & COLOUR MONITOR:**

5.2.14.1 Printer shall be a part of the supervisory system. It shall print out all alarm/trip conditions and event changes in plant status along with date and time of occurrence. The time least count for event recording shall not be more than 100 m secs. Printer provided shall be ink jet type. The make of the same shall be subjected to Purchaser's approval.

5.2.14.2 51 cm IBM compatible color monitor having 8 different colors with graphic facility shall be provided for control/monitoring and programming purposes. Configured keyboard with well defined levels and color coding shall be provided.

5.2.15.0 **REMOTE I/O COMMUNICATION LINKS**

5.2.15.1 The I/O communication system shall have two independent links that are continuously checked for failure. Any failure of communication links shall result in annunciation.

5.2.15.2 Bidder shall provide and install two runs of pre-fabricated plug in type shielded cables between I/O modules and PLC. In case of remote I/O's the communication link shall be operable when installed in underground conduits and may be subjected to submersion in water. The Bidder shall supply complete information for specification of the communication cables.

5.2.16 **SYSTEM REACTION TIME**

5.2.16.1 The reaction time of the programmable control system from input signals at the input cards to output of the associated signals or commands of the output card inclusive of programmed logic processing, comprising a mixture of logic gates, arithmetic operations and other internal operations shall be less than 100 milli seconds under the most arduous control system operating conditions.

6.0 **QUALITY ASSURANCE PROGRAMME (QAP)**

6.1 All material, components and equipments covered under this specification shall be procured, manufactured, erected, commissioned and tested at all stages, as per a comprehensive Quality Assurance Programme. Bidder shall draw up and implement such program duly approved by the Purchaser. The detailed quality plans for manufacturing and field activities should be drawn up by the Bidder separately and will be submitted to Purchaser with the bid.

6.2 Manufacturing Quality Plan shall be detail out for all the components and equipments for various tests & inspection, to be carried out as per the requirements of this specification and standards and codes mentioned therein and standard quality practices and procedures adopted by Quality Control/Test houses of repute. The relevant reference documents and standards acceptance, norms, inspection documents etc. shall be referred during all stages of material procurements, manufacture, assembly and final testing/performance testing.
6.3 Field Quality Plan shall detail out the quality practice and procedures etc. to be followed by the bidder at site during various stages of activities from receipt of material/equipments at site to storage, reservation, site fabrication, erection, and final trial run and commissioning.

6.4 The bidder shall also furnish copies of the reference documents/plant standard/acceptance norms/test and inspection procedures etc. as referred in quality plan along with quality plans. The quality plans and reference documents/standards etc. shall be subject to Purchaser's approval and shall form a part of the work contract. In the approved quality plan, the Purchaser shall identify Customer Hold Points (CHP) which shall be carried out in presence of the Purchaser's engineer and beyond which work shall not proceed without return consent of the Purchaser /his authorised representative in writing. However, this shall not relieve and discharge Bidder of his responsibility for Quality Standards and performance requirements as per this specification.

6.5 Purchaser reserves the right to witness any of the test and verify the documents of the Bidder and his sub contractor. No materials/equipment shall be dispatched from the manufacturer's works before the same is duly cleared for despatch by the Purchaser.

6.6 The list of sub vendors proposed by the Bidder for procurement of major bought out items including raw materials, semi finished and finished components and equipments shall be drawn up by the Bidder for Purchaser's approval.

6.7 The Bidder shall carry out an inspection and testing program during manufacture in his works and that of his sub vendors to ensure the mechanical accuracy of components, compliance with drawings, conformity to functional and performance requirements and the acceptability of all materials, parts and equipments. Bidder shall carry out all tests/inspection required to establish that items/equipments conform to requirements of the specification and the relevant codes/standards specified , in addition to tests as per the approved Quality Plan.

7.0 TESTS

7.1 All the devices components being supplied shall be subjected to type test, routine test as specified below. The Purchaser reserves the right to witness any or all the tests for which at least 20 days advance notice shall be given by the Bidder. Six copies of all test reports shall be submitted for approval by Purchaser before despatch of the devices/components from works.

7.2 The Purchaser reserves the right to waive any of the Type tests in which case, the test changes quoted shall be taken for adjustment purpose.

7.2.1 Type Test:

The following type tests shall be carried out on the equipment:

7.2.2 Dry heat withstand test, as per cl. no. 2.4.1 of IEC-65A, Part - 5
7.2.3 Variation of temperature immunity test, as per cl. No.2.4.5 of IEC-65A, Part-5.
7.2.4 Vibration immunity test, as per cl. no. 2.5.1 of IEC-65A, Part-5
7.2.5 Degree of protection, as per IS : 2147
7.2.6 Tests for internal and external wiring cable as per cl. no. 2.5.8 of IEC-65A, Part-5.
7.2.7 Temperature Cycle Test:

All CPUs, I/Os, I/O adaptor modules, power supply units shall be tested at the specified ambient condition in a controlled thermal test chamber. The test shall
be carried out for 48 hours. The equipment is expected to function satisfactorily throughout the test period and no electrical/mechanical damage/deformation observed after the test.

During this test, cubicle doors shall be in the position same as they are supposed to be in the field. Maximum temperature rise inside the cubicle shall not exceed 10 °C above the testing temperature.

7.2.8 Dielectric test as per Clause No. 2.6.1 of IEC-65A, Part-5
7.2.9 Noise immunity test as per cl. no. 2.6.42.4 of IEC - 65A, Part-5
7.2.10 Incoming power supply voltage and frequency variation test as per cl.no. 2.7 of IEC - 65 A , Part-5
7.2.11 Tests on verification of functional characteristics of I/Os as per Clause No. 2.8 of IEC - 65A, Part - 5.
7.2.12 Task transition test as per Clause No. 2.1.2.3.1 of IEC - 65A, Part - 5. For each task, the Bidder shall list out the user accessible conditions which shall be used in the simulation of the task.

7.3 Routine Test:
The following Routine tests shall be carried out:

7.3.1 Proper functioning verification test and hardware integrity test as per cl. no.2.2 of IEC- 65A, Part - 5. During functional test following shall be carried out:
   a) Simulation of the system with relays, solenoid valves or equivalent loads.
   b) Print out of ladder diagram
   c) Battery back up failure test
   d) Timer/Counter functions checks
   e) Measurement of response time

7.3.2 Dielectric strength test as per cl. no. 3.1 of IEC-65A, Part - 5.

7.4 Visual test:
7.4.1 a) Make and type of the different components as per manufacturer's literature and drawings
   b) Making as per cl. no. 2.5.9 of IEC - 65A
   c) Finish
   d) Terminal clearance of field wiring as per cl. no. 2.5.6 of IEC - 65 A Part - 5.

7.4.2 Tests on control panel
7.4.2.1 The following tests/inspection shall be carried out on the control panel
Factory Tests:
1) Compliance with approved drawings, data and specification
2) Visual check for workmanship
3) Wiring continuity and functional check
4) Calibration of instruments, relays and meters wherever required
5) HV test, insulation resistance measurement before and after HV test using a 1000 V megger. Insulation resistance shall be not less than 25 megger.
6) Testing to observe compliance to a degree of protection shall be only as under:
   It shall not be possible to insert a thin sheet of paper under gaskets and through enclosure joints.
7.4.3 **Inspection/Testing at site:**

1. IR test before and after HV test
2. HV test
3. Functional testing
1.0 **SCOPE**

1.1 This specification covers the requirements for three phase foot/flange mounted continuous rating and duty type induction motors.

1.2 The motors shall comply with the latest version of IS 325 & IEC 34-1 except where modified or extended by this specification and with the relevant parts of standards mentioned in para 2.0.

1.3 Any material and component not specifically stated in this specification but necessary for trouble free operation of the motor and its accessories specified herein shall be deemed to be included.

2.0 **OTHER RELEVANT STANDARDS**

2.1 The other relevant standards applicable are as under:

- IS: 900 Code of practice for installation and maintenance of induction motors
- IS: 8223 Dimensions and output ratings for foot mounted electrical machines with frame number 355 to 1080
- IS: 1231 Dimension of three phase foot mounted induction motors
- IS: 210 Frames for flange mounted induction motors
- IS: 2223 Dimension of flange mounted induction motors
- IS: 210 Frames for rotating electrical machines
- IS: 1271 Classification of insulating materials for electrical machinery and apparatus in relation to their thermal stability in service
- IS: 2253 Designation for type of construction and mounting arrangement for electrical machines
- IS: 3043 Code of practice for earthing
- IS: 1885 Electro technical vocabulary - Part XXXV rotating machines
- IS: 4691 Degree of protection provided by enclosures for electrical machinery
- IS: 4722 Rotating electrical machinery
- IS: 6362 Designation of methods of cooling for rotating electrical machinery
- IS: 7816 Guide for testing insulation resistance of rotating electrical machinery
- IS: 12065 Permissible limits of noise level for rotating electrical machines
- IS: 12075 Mechanical vibrations of rotating electrical machines
- IS: 2147 Degree of protection provided by industrial enclosures
- IS: 4889 Method of determination of efficiency of rotating electrical machines
- IS: 8789 Values of performance characteristic for three phase induction motors
- IS: 1076 Preferred numbers
- IS: 12802 Temperature rise measurement of rotating electrical machines
- IS: 3003 Carbon Brushes for electrical machines
- IS: 5 Colours for ready mixed paints and enamels
- IS: 4729 Measurement and evaluation of vibration of rotating electrical machines
- IS: 4889 Method of determination of efficiency of rotating electrical machines
- IS: 8789 Values of performance characteristic for three phase induction motors
- IS: 12824 Type of duty and classes of rating for rotating electrical machines
- IS: 1076 Preferred numbers
- IS: 12802 Temperature rise measurement of rotating electrical machines
- IS: 3003 Carbon Brushes for electrical machines
- IS: 5 Colours for ready mixed paints and enamels

Equipment complying with other internationally accepted standards shall also be considered if they ensure performance and constructional feature or superior standards listed above. In such a case the bidder shall clearly indicate the standards adopted, furnish a copy in English of the latest revisions along with the copies of all amendments and revisions in force as on opening of the bid and clearly bring out salient features for comparison.
3.0 SITE CONDITION

3.1 Ambient Conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient air temperature</td>
<td>50°C(-) 5°C to (+)50°C</td>
</tr>
<tr>
<td>Altitude</td>
<td>Maximum upto 1000 MSL</td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>Approximately 97%</td>
</tr>
<tr>
<td>Pollution degree</td>
<td>Degree 4 as per IS : 13947 (Part I) (i.e. the pollution generates persistent conductivity caused by conductive dust)</td>
</tr>
<tr>
<td>Location</td>
<td>Heavily polluted with coal dust</td>
</tr>
</tbody>
</table>

4.0 RULES

4.1 The design and operational features of the equipment offered shall comply with the requirements of the latest version of the Indian Electricity Rules and the National Electricity Code.

5.0 DESIGN

5.1 Electrical

a) The motor shall be preferably EEF-1 type, continuous duty (S1) and rating type in accordance with relevant code. The locked rotor torque and the break away torque as percentage of full load torque and the locked rotor current as percentage of full load current at rated voltage and the full load slip and power factor shall conform to the values indicated in Annexure-I.

b) The temperature measured over the surface of the motor shall not exceed 70°C over the ambient air for the class of insulation B and 80°C for class F in accordance with relevant code.

c) The measurement of temperature shall be in accordance with relevant code.

d) The motor shall be designed to deliver rated output with the terminal voltage differing from its rated value by not more than ± 10%, frequency differing from its rated value by not more than ± 6% and any combination of these limited to 10%.

e) The cage motor shall be capable of withstanding the forces associated with the maximum in rush current , the locked rotor torque and the pull out torque at the highest system voltage and at the upper limit of supply frequency during starting.

f) The cage motors shall be capable of starting with load at a terminal voltage of 80% of the rated voltage.

g) The motor shall be suitable for two cold starts in succession under the normal loading condition.
h) The motor shall withstand for 15 seconds without stalling or abrupt change in speed under gradual increase of torque up to 1.6 times its rated value, the voltage and frequency being maintained at their rated value.

i) The accelerating torque at any speed with the lowest starting voltages shall be at least 10% of rated full load torque.

5.2 Mechanical

a) The method of cooling for LT/HT motors shall be IC-0141 or IC-0151 depending upon the system requirement.

b) The enclosures for motor shall be of IP44 design for indoor location and IP54 design for outdoor in accordance with relevant code.

c) The motor vibration shall confirm to the requirements in accordance with relevant code.

d) The motor noise level shall confirm to the requirements in accordance with relevant code.

6.0 CONSTRUCTIONAL DETAILS

6.1 General

a) The motor and its components such as stator, rotor end shield, terminal boxes and the bearings shall be designed to be readily inter-changeable as integral units for the same design and rating.

b) All non-metallic components used shall be resistant to flame propagation

c) All heavy parts of the motors shall be provided with necessary lifting arrangements

6.2 Stator frames and shields

a) The stator frames and end shields shall be rugged and made of cast iron conforming to relevant code. Cast Aluminium body is not acceptable. The stator frame shall have deep ribbed construction machined to ensure concentricity and correct alignment for reliability and ease of maintenance.

b) The frame holding the stator core and windings must be strong and rigid to withstand short circuit force and unbalanced magnetic pull and minimise vibrations. The cover holding the frame shall be bolted to it and strong enough to hold the bearings in position.

6.3 Cooling arrangements

a) HT and LT motors shall be Totally Enclosed, Fan Cooled, (TEFC-0141) by a light weight cast Aluminium fan of bi-directional design and very low inertia. The fan shall be keyed to the shaft and protected by a cowl. The motors for Plough Feeders shall be Flameproof type.

6.4 Enclosures

The enclosure shall be totally enclosed fan cooled with suitable means for breathing and drainage. The drain hole diameter shall not exceed 6 mm.

6.5 Stator

a) The stator core shall be built up of low loss high permeability steel laminations assembled under pressure and rigidly secured by end plates and key rings.

b) The winding shall be two layer type consisting of synthetic enameled copper
conductors in Semi closed slots.
c) Insulation shall be class-B for 440V motors and class -F for HT motors.
d) All winding insulations shall be non-hygroscopic and resistant to flame propagation. All insulations shall be impregnated and suitably processed to effectively seal them to prevent deterioration from adverse environmental conditions at site.
e) Stator windings shall be tight fit in their slots.
f) All winding overhangs and leads shall be adequately supported braced and blocked.

6.6 **Rotor**

a) The rotor core shall be of similar construction to that of the stator
b) The cage bars for cage motors shall be of copper.
c) Copper bars extending beyond the core shall be brazed to copper end rings.
d) The complete rotor shall be dynamically balanced with the fan on the shaft for TEFC motors and with integral heat exchangers for CACA motors ensuring vibration free smooth running.
e) The cage bars and all joints shall ensure safety against fatigue failure against thermal and mechanical stresses during starting and abnormal conditions including faults.
f) Rotor windings shall be tight fit in their slots

g) Rotor winding overhangs and leads shall be adequately supported braced and blocked

h) Brush gears, commutators and slip rings for slip ring motors shall be suitable for operation without injurious sparking and for runs for at least three months without the need for adjustment or replacements of brushes. Brushes shall be of electrographic or metal graphite type. Commutator shall be industrial type. Adequate precaution shall be taken to protect the windings, commutators, slip rings and brush gears against deposits of entrained carbon dust. Brush holders shall be of brass/bronze materials and located securely to accurately position the brushes on commutators. Means for adjusting brush pressure to prevent passage of current through pressure device shall be provided.

6.7 **Shaft**

a) The shaft shall be manufactured from high grade steel, preferably C-40. The sustained deflection of the shaft shall well below 10% of the air gap.

6.8 **Bearings**

a) The bearings shall be ball / roller type for 440 V motors and roller / pedestal type for HT motors.

b) The bearings shall be designed to prevent ingress of dust and water and shall be sealed against leakage of lubricant along the shaft. The bearings shall be self lubricated.

c) The bearings shall be in accordance with the relevant codes.

d) 440 V motors shall be grease lubricated. 6.6 kV motors shall be oil lubricated.
e) The housing for the bearings shall be correctly packed with Lithium based grease at the time of assembly. Construction shall be such that the bearings can be dismantled without risk of damage.

6.9 Terminal box

a) Terminal boxes integral with the stator frame shall be provided with terminals for stator leads. Additional terminal box shall be provided for slip ring motors.

b) The terminal boxes and termination arrangement shall be designed for easy connection and replacement of cables. Leads from terminals to the windings shall be adequately sized and braced to withstand the heating and forces produced by maximum fault current.

c) Terminals shall be suitable for receiving Aluminium conductor PVC/XLPE insulated cables.

d) Clearance between the lugs/bars/live parts of different phases and between lugs/bars/live parts and earth shall be as indicated in Annexure-1. The terminal boxes shall be capable of withstanding a system fault level as indicated in Annexure-I. Terminal boxes shall be suitable for top entry of cables.

6.10 Earthing terminals

Two independent earthing terminals shall be provided in accordance with I.E Rules on diagonally opposite corners of the motor for bolted connection.

6.11 Rating plate

The rating plate shall indicate the parameters as indicated in the para 8.0

6.12 Paint & finish

All fasteners used in the construction of the equipment shall be either of corrosion resistant material or heavy cadmium plated. Current carrying fasteners shall be of stainless steel.

6.13 Mounting

The mountings shall be as under:
The motors for crushers, pumps, compressors, fans, and blowers shall have the mounting B3 and the motors for conveyors, reciprocating feeders and screens shall have the mounting B5 in accordance with DIN 42950 or as specified elsewhere in this tender..

6.14 Auxiliary devices

The motor shall be suitable for the auxiliary devices mentioned below:

<table>
<thead>
<tr>
<th>Type of load</th>
<th>Auxiliary devices on the shaft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressor and fans</td>
<td>Pulleys</td>
</tr>
<tr>
<td>Conveyors, feeders and Screens</td>
<td>Gears/Fluid coupling</td>
</tr>
<tr>
<td>HT motors</td>
<td>Neutral current transformer 1 no., Embedded Resistance Temperature Detectors (RTD) 6 nos for windings with additional 2 nos for bearings of motor above 200 KW and Heater 230 V 1 no.</td>
</tr>
</tbody>
</table>

7.0 Performance

The values of minimum full load speed, maximum full load current, minimum pull out torque and minimum locked motor torque as percentage of full load torque at rated voltage and frequency for duty type S1 shall be in accordance with relevant code.
8.0 **Rating Plate**

8.1 A rating plate stating the following information shall be supplied with each motor:

- a) Reference standard
- b) Name of manufacturer
- c) Manufacturer's number and frame reference
- d) Type of duty
- e) Class of insulation
- f) Frequency in Hz
- g) Number of phases
- h) Rated output in kW
- i) Rated voltage and winding connections
- j) Current, approximate in amperes at rated output
- k) Speeds in revolutions per minute, at rated output
- l) Rotor (Secondary) voltage and winding connections
- m) Rotor (Secondary) current in amperes at rated output
- n) Ambient temperature
- o) Enclosure Type

9.0 **Tests**

The bidder shall submit certificates for the Type and Routine tests carried out at manufacturer’s works.

9.1 **Type Tests**

These shall be carried out on a motor identical in essential details with the one for which this specification is drawn. The following shall constitute the type tests.

- a) Measurement of stator resistance and rotor resistance in case of slip ring motors.
- b) No Load running of motor and reading of current in the three phases and voltage.
- c) Open circuit voltage ratio in case of slip ring motors.
- d) Reduced voltage running up test at no load to check the ability of the motor to run up to full speed on no load in each direction of rotation with 60% of the rated line voltage applied to the stator terminals in case of squirrel cage motors.
- e) Locked rotor readings of voltage, current and power input at a suitable reduced voltage.
- f) Full load reading of voltage, current, power input and slip.
- g) Temperature rise test.
- h) Momentary overload test. i) Insulation resistance test. j) High voltage test.

9.2 **Routine tests**

These shall be carried out on a motor for which this specification is drawn. The following shall constitute the routine tests.

- a) Insulation resistance test
- b) High Voltage test
- c) No load running of motor and reading of current in the three phases and voltage
- d) Locked rotor readings of voltage, current and power input at a suitable reduced voltage
- e) Reduced voltage running up test at no load to check the ability of the motor to run up to full speed on no load in each direction of rotation with 60% of the rated line voltage
voltage applied to the stator terminals (for squirrel cage motors only) and
f) Open -circuit voltage ratio (for slip-ring motors only).

10.0 MULTIPRODUCT DIGITAL TEMPERATURE SCANNER

10.1 The digital temperature scanner of required number of channels for monitoring bearing and winding temperature of 6.6 kV motors shall be provided in respective control consoles. For each motor eight points are to be monitored, 2 for bearing and six for winding. For all the points RTD probes shall be provided in the bearings and the windings of the motors.

10.2 For accurate processing of the information the scanner shall be provided with software diagnostic monitor, to monitor the validity of the instructions and give error message in the event of wrong programme entries. A key switch locks out all the programmable functions for scrutiny. The scanners shall also have battery back up to ensure that the programme is not lost in case of power failure and the provision of the same shall be in the scope of this tender.

10.2 Specific Features

The scanners shall have two alarm levels per channel which shall be assigned as “High” and “Extra High”. When the motor (bearing or winding) achieves high temperature the audio-visual alarm shall be switched on at respective control console, but if the temperature rises further and reaches extra high level, the motor shall trip automatically with an audio-visual signal, thereby stopping all the equipment/drives which are ahead in sequence. The scanner shall also have the facility of monitoring any channel without stopping the scanning and automatic increment of channel display at every 4 seconds for manual data logging. The tenderer shall bring out the salient features of the scanner to be offered explaining its working. The bidder shall also enclose manufacturer's catalogue/technical leaflets in support.
ANNEXURE- 1.

1 Technical Specification has been given in Annexure I.

2 Service conditions
   - Maximum $70^\circ$ C over ambient for class B & $0-80^\circ$ C for class F

   a) Altitude
      - Maximum up to 1000M above MSL

   b) Location
      - Heavily polluted with coal dust medium

3. Rated voltage (with percent variation) 440/6600V +10%
4. Frequency (with percent variation) 50Hz(+.6%)

5. Class of duty Contineous (S 1)
6. Type of rating Contineous
7. Class of insulation of motor ClassB for 440 V & class F for HT

8. Temperature rise allowed over the ambient air $70^0$C classB of 440V & $80^0$C for class F of HV motors

9. Type of enclosure of motor : TEFC
10. Degree of protection for enclosure of motor
    - IP 44 for indoor & IP 54 for outdoor motors, Flameproof for motors of Plough Feeders

11. Degree of protection for terminal box : IP 54
12. Method of cooling : IC 0141/ IC 0151
13. Lubrication of bearings
    - Lithium grease for roller and thrust bearings, oil for pedestal bearings

14. Mounting
    - Horizontal foot (B3)/Flange or Face (B5)/As per requirement

15. Type of rotor
    - Squirrel cage/Slip ring

16. No. of poles 4/6/8/10
17. Maximum value of slip 5 Percent
18. Mechanical output in kW
    - 5.5/7.5/11/15/18.5/22/30/37/45/5
    - 5/79/100/110/120/150/175/200/2
    - 25/250/300/330/350/375/420
    - /450/525/600/750/900/1200/1600
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Value/Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>No. of phases</td>
<td>Three</td>
</tr>
<tr>
<td>20</td>
<td>Minimum power factor at full load</td>
<td>0.85 for motors upto 18.5 kW, 0.90 for motors above 18.5 kW</td>
</tr>
<tr>
<td>21</td>
<td>Minimum efficiency at full load</td>
<td>90% for motors above 18.5 kW</td>
</tr>
<tr>
<td>22</td>
<td>Maximum value of locked rotor current as percentage of full load current</td>
<td>650% for motors above 18.5 kW</td>
</tr>
<tr>
<td>23</td>
<td>Minimum value of locked rotor torque as percentage of full load torque</td>
<td>185% for motors above 18.5 kW</td>
</tr>
<tr>
<td>24</td>
<td>Minimum value of pull out torque as percentage of full load torque</td>
<td>200% for motors above 18.5 kW</td>
</tr>
<tr>
<td>25</td>
<td>Clearance between phases at terminal box</td>
<td>10 mm for 440 V motors 70 mm for 6600 V motors</td>
</tr>
<tr>
<td>26</td>
<td>Clearance between phases to earth at terminal box</td>
<td>10 mm for 440 V motors 70 mm for 6600 V motors</td>
</tr>
<tr>
<td>27</td>
<td>Switching Impulse Withstand level for 1.2/50 microsec</td>
<td>19 kV for 6600V</td>
</tr>
<tr>
<td>28</td>
<td>Fault withstand level for terminal box</td>
<td>31 MVA for 415V motors &amp; 250 MVA for 6.6 kV motors</td>
</tr>
<tr>
<td>29</td>
<td>Particular of test requirements</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) Certificate for Type tests issued by a test house of repute conducted on one motor of a lot having specification Required</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b) Certificate for Routine tests issued by a test house of repute conducted on each motor having specification identical to Required</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td><strong>Multipoint Digital Temperature Scanner</strong></td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>No. of channels</td>
<td>As required</td>
</tr>
<tr>
<td>b)</td>
<td>Temperature range</td>
<td>Suitable for motor application</td>
</tr>
<tr>
<td>c)</td>
<td>Scanning speed</td>
<td>15 Channels/Sec.</td>
</tr>
<tr>
<td>d)</td>
<td>Display</td>
<td>Bright Red LED Display</td>
</tr>
<tr>
<td>e)</td>
<td>Dimension</td>
<td>Suitable for installation on control console</td>
</tr>
<tr>
<td>f)</td>
<td>Power supply</td>
<td>110 V AC ± 10%, 50 Hz ± 3%</td>
</tr>
</tbody>
</table>
SPECIFICATION FOR CAPACITOR BANKS (Refer Drawing Nos. RI-2/E&M/000031)

1.0 SCOPE
1.1 This specification covers requirements for 6.6 kV shunt capacitor banks suitable for indoor installation.
1.2 The capacitor banks shall comply with the latest version of IS : 2834 and IEC-831-1 & 831-2 except where modified or extended by the provision of this specification and with the relevant parts of standards mentioned in clause 2.0.
1.3 Any material and component not specifically stated in this specification but necessary for trouble free operation of the equipment and accessories specified herein shall be deemed to be included. Nothing in this specification shall be construed as to relieve the supplier of the responsibility for correctness of the design and construction of the equipment.

2.0 OTHER RELEVANT STANDARDS
The other relevant Indian Standards are as under:

IS : 12672 Internal fuses and internal over pressure disconnectors for shunt capacitors
IS : 9046 A.C. contactors of voltages above 1000 V up to and including 11000V
IS : 13118 General requirements for circuit breakers for voltages above 1000V
IS : 9920 Switches and switch isolators for voltages above 1000 V
IS : 13947 L.V. switch gear and control gear (Part 4 section 1-contactors)
IS : 13947 L.V. switch gear and control gear (Part 3 - switches)
IS : 13947 L.V. switch gear and control gear (Part 2 - circuit breakers)
IS : 9402 High voltage fuses for the external protection of shunt capacitors
IS : 13703 L.V. Fuses for voltages not exceeding 1000V A.C.
IS : 7098 Cross linked polyethylene insulated PVC sheathed cables up to and including 33 kV
IS : 3043 Code of practice for earthing

In case of conflict between this specification and those (IS codes, standards etc) referred to herein, the former shall prevail.

The equipment covered under this specification shall comply with all the latest applicable statutory rules, regulations, acts and safety codes which may be in force during the period of supply/execution and which are related with design, construction and operation of equipment in the locality where the equipment is to be installed.

Equipment complying with other internationally accepted standards such as BS, VDE and ANSI are also acceptable if they ensure performance and constructional feature equivalent or superior to standards listed before. In such a case the bidder shall clearly indicate the standard adopted, furnish a copy in English of the latest version along with copies of all official amendments.
3.0 SERVICE CONDITION

Operating condition
(a) Nominal system voltage  6600 V (± 10 %)
(b) Supply frequency  50 Hz (-5 to +3 %)
(c) Earthing Effectively earthed
(d) Highest fault level  31 MVA / 250 MVA

Location
(a) Maximum ambient temperature - Mean over one year 35 deg Celsius
(b) Maximum ambient temperature - Mean over 24 hours 45 deg Celsius
(c) Maximum ambient temperature - Mean over 1 hour 50 deg Celsius
(d) Maximum relative humidity - Mean over 1 hour 100 %
(e) Pollution - Heavily polluted with coal dust

4.0 DESIGN

The capacitor units shall be designed for the following:
(a) Watt losses between 0.2 to 0.5 kW per kVAR
(b) Temperature withstand category of 55° C
(c) Output (kVAR) tolerance not exceeding 10 %
(d) Capacitor - fuse co-ordination to reduce risk of tank rupture
(e) Use of bio degradable eco friendly dielectric compound
(f) Switching life not less than 60,000 operations

5.0 CONSTRUCTION

5.1 The basic units shall be made of dielectric compound polypropylene film impregnated with non-PCB bio-degradable liquid. Foil shall be preferred over paper for better heat dissipation and lower operating temperature.

5.2 The electrodes shall be metal alloy special vacuum deposited with reinforced edges to sustain the faults.

5.3 The basic units shall be insulated for power frequency withstand voltages.

5.4 The basic units shall be provided with protection against sustained overload, earth fault and voltage / current unbalance.

5.5 Each unit shall be provided with self healing type pressure sensitive detector for sensing excessive internal pressure.

5.6 Each unit shall be provided with pressure activated tripper switch for tripping.

5.7 Each bank shall be provided with discharge resistors.

5.8 Each unit shall be supplied in a M.S. container with enamel paint finish.

5.9 The bank shall be supplied with peripherals indicated in the annexure.

5.9.1 Each unit shall be designed for withstanding inrush current as indicated in the annexure

5.10 The capacitor banks shall be complete with automatic power factor correction relay.

5.11 The unit shall be hermetically sealed and mounted on steel racks which are built up into stacks of desired rating.
5.12 Each element of capacitor unit shall have its own built in special fuse. In case of fault in an element, the over voltage on the remaining elements shall not exceed 10%. Internal discharge resistance shall be provided to limit the residual voltage to less than 50 volt as per relevant standard.

5.13 The capacitor banks shall be designed to withstand electro-dynamic and thermal stresses caused by transient over currents during switching.

5.14 To eliminate unduly frequent switching when peak load of short duration occur, a time relay shall be incorporation.

5.15 To eliminate unduly frequent switching when peak load of short duration occur, a time relay shall be provided.

5.16 Zero voltage relay shall be provided to reset the control devices to their neutral position, so that on restoration of supply after any supply interruption, the capacitor stages are switched on again without any undesirable current and voltage peak.

6.0 PERFORMANCE

6.1 The unit shall deliver rated output within the limits of watt losses indicated in clause 4.0 without over heating within the limits of ambient temperature indicated in clause 3.0

6.2 The Capacitor Banks shall be grouped in different kVAR rating, which shall be switched ON/OFF as required according to load connected. For this purpose capacitor kVAR shall be subdivided into a number of regulating stages. The regulating stages shall be switched ON/OFF by means of suitable relay to ensure the system power factor to 0.98 lagging. To eliminate unduly frequent switching when peak load of short duration occur a time delay relay shall be incorporated for stage to stage switching. In case of supply interruption a NO volt relay shall set the control devices to their neutral position. The tenderer shall also provide necessary reactive power relay, No volt relay, control devices and switching devices mounted separately in a dust tight vermin proof sheet metal enclosed cubicle suitable for floor mounting. This cubicle shall also be provided with other devices, such as, current and voltage transformer, protective relays, voltmeter, ammeter with selector switch, auxiliary relay etc., which are essential for automatic switching of capacitor banks.

All internal wiring for control sensing instruments, relays etc. shall be done with 650V grade, PVC insulated copper conductor of size not less than 2.5 mm². The capacitor bank shall be rated for continuous operation and shall be suitable for indoor installation.

The Bidder shall indicate the level of improved power factor in the offer.

7.0 TESTS AND TEST REPORTS

7.1 The bidder shall submit report of type tests in accordance with the relevant code conducted on a piece of equipment having specification identical to the one included in this document.

7.2 The successful bidder shall submit report of routine tests in accordance with the relevant code conducted on each piece of equipment for which this specification is drawn.
8.0 QUALITY ASSURANCE PROGRAMME

8.1 All materials, components and equipments covered under this specification shall be procured, manufactured, erected, commissioned and tested as per a comprehensive quality assurance programme to be approved by the purchaser. The quality assurance plan furnished by the successful bidder shall include copies of the reference documents, plant standards, acceptance norms and test & inspection procedure to be adopted. In the quality assurance plan the purchaser shall identify Customer Hold Points (CHP) which shall be carried out in presence of purchaser’s representative and beyond which the work shall not proceed without the written consent of the purchaser.

8.2 The purchaser reserves the right to witness any or all of the tests identified in the Customer Hold Points and verify the documents also mentioned in the Customer Hold Points.

8.3 The sub venders proposed by the successful bidders, if any, for procurement of major bought out items including finished, semi finished, assembled and raw materials shall be subject to purchaser’s approval.

8.4 The successful bidder shall carry out the tests and inspections as per QAP aforesaid at his works to check the accuracy of components, compliance with drawings, conformance to functional and performance requirements, identify and accept all materials and components. The tests shall establish that the equipment offered confirms to the requirements of this specification and relevant codes/standards also included in this specification.

8.5 Approval of the test results conducted as per QAP will not however prejudice the right of the purchaser to reject the equipment if it does not comply with the requirements of this specification and does not give complete satisfaction and will not limit the liabilities and responsibilities of the successful bidder in ensuring the complete conformance of the equipment supplied to this specification and relevant codes/standards also included in this specification.
## TECHNICAL SPECIFICATION

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Applicable Standard</strong></td>
<td>IS : 2834</td>
</tr>
<tr>
<td><strong>System</strong></td>
<td>6600 volts, 3 phase 50 Hz solid earthed system</td>
</tr>
<tr>
<td><strong>Location</strong></td>
<td>6,6 kV Switching station</td>
</tr>
<tr>
<td><strong>No. of phases</strong></td>
<td>Three</td>
</tr>
<tr>
<td><strong>Connection</strong></td>
<td>Star/Delta</td>
</tr>
<tr>
<td><strong>Output kVAR</strong></td>
<td>As required</td>
</tr>
<tr>
<td><strong>Insulation level</strong></td>
<td>22 kV for One minute</td>
</tr>
<tr>
<td><strong>Overload</strong></td>
<td>1.3 times rated current continuously</td>
</tr>
<tr>
<td><strong>Losses</strong></td>
<td>Less or equal to 0.5 W/ kVAR</td>
</tr>
<tr>
<td><strong>Output tolerance</strong></td>
<td>10 % (Max)</td>
</tr>
<tr>
<td><strong>Inrush Current</strong></td>
<td>Not exceeding 100 times rated current</td>
</tr>
<tr>
<td><strong>Peripherals to be supplied</strong></td>
<td>Discharge resistors, HRC Fuse, Racks, Isolators</td>
</tr>
<tr>
<td><strong>Accessories</strong></td>
<td>Control Panel with Automatic P.F. Correction relay</td>
</tr>
<tr>
<td><strong>Discharge device</strong></td>
<td>Discharge Resistor</td>
</tr>
<tr>
<td><strong>Container</strong></td>
<td>MS Sheet at least 3 mm thick</td>
</tr>
</tbody>
</table>
SPECIFICATION FOR EARTHING & LIGHTNING PROTECTION SYSTEM

1.0 SCOPE

1.1 This specification covers the requirements for earthing system.

1.2 Earthing system shall be in strict accordance with IS : 3043 and Indian Electricity Rules/Acts.

1.3 Any material, component or accessory not specifically stated in this specification but necessary for trouble free operation shall be deemed to be included.

2.0 SYSTEM DESCRIPTION

2.1 The earthing system shall consist of earth pits and earthing conductors located in & around the switchtngstation buildings and CHP.

2.2 Independent pits shall be provided for earthing of transformer neutrals and down conductors of lightning masts. Inter connected pits shall be provided for frame earthing of all equipments and cable trays/ladders, metallic conduits, steel tubular poles, trusses & structures over which cables run.

3.0 CONSTRUCTION

The primary requirements of the earthing system are as follows:

3.1 Neutral of a transformer shall be effectively connected to an independent earth pit by copper flat 65 x 8 mm.

3.2 Down conductor of a lightning mast shall be effectively connected to an independent earth pit by GS flat 65 x 8 mm.

3.3 Frame work of equipment shall be effectively connected to nearest pit by two separate GS flats or a combination of GS flats & wires of the sizes mentioned below:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Earth conductor buried in earth</th>
<th>Earth conductor above ground level &amp; in built up trenches</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Main earth grid</td>
<td>40 mm dia MS Rod</td>
<td>65 x 8 mm GS flat</td>
</tr>
<tr>
<td>b) All H.T. Equipment</td>
<td>Not applicable</td>
<td>65 x 8 mm GS flat</td>
</tr>
<tr>
<td>c) 415 V/230 V Switch boards</td>
<td>Not applicable</td>
<td>50 x 6 mm GS flat</td>
</tr>
<tr>
<td>d) LT motors above 125 kW 31 kW to 125 kW 1 kW to 30 kW Fractional Horse Power</td>
<td>Not applicable</td>
<td>50 x 6 mm GS flat</td>
</tr>
<tr>
<td>e) Columns, structures, cable trays, bus duct enclosures, steel tubular poles &amp; Towers</td>
<td>Not applicable</td>
<td>25 x 6 mm GS flat</td>
</tr>
<tr>
<td>f) Crane gantries and other non-current carrying metal parts</td>
<td>Not applicable</td>
<td>25 x 6 m GS flat</td>
</tr>
</tbody>
</table>
3.4 Each earth pit shall have MS pipe electrode not smaller than 38 mm. The buried length of the electrode shall not be less than 2.5 meters. Each electrode shall be buried vertically in an earth pit of minimum 300 mm x 300 mm area and 3 meters depth in alternate layers of charcoal and salt.

3.5 All conductors for earthing shall be made of Galvanised Steel (GS) on surface and of Mild Steel (MS) when planted below soil.

3.6 The joints of the conductors shall be preferably welded. For rust protection the welds shall be treated with Barium Chromate. Welded surfaces shall be painted with Lead primer and Aluminium paint followed by coats of Bitumen paints.

3.7 The grids inter connecting the pits shall have an area not less than 300 Sq mm and be buried at a depth not exceeding 600 mm below the soil. Back filling material to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 150 mm. Earthing conductors embedded in the concrete floor of the building shall have approximately 50 mm concrete cover.

3.8.1 Each pit shall be provided with a cast iron top cover for inspection & identification.

3.9 The earth conductors shall be free from pitting laminations, rust, scale and other electrical, mechanical defects.

3.10 The Bidder shall design and install the grounding system in the entire CHP Complex including switchingstation buildings. Excavation in rock / soil or both and back good earth filling required for the construction shall be in the scope of the bidder.

3.11 Metallic frame of all electrical equipment shall be earthed by two separate and distinct connections to earthing system each of 100% capacity. Crane rails, metal pipes and conduits shall be effectively earthed at two points. Steel RCC columns, metallic stairs, hand rails etc. of the sub-station building housing electrical equipment shall be connected to the nearby earthing grid conductor by one earthing ensured by bonding the different sections of hand rails and metallic stairs. Metallic sheaths, screens, armour of all cables shall be earthed at both ends.

3.12 Each continuous laid out lengths of cable tray shall be earthed at minimum two places by GS flats to the earthing system, the distance between earthing points shall not exceed 30 metre. Different sections of cable trays shall be connected by low resistance connecting links.

3.13 The neutral of transformer shall be connected to neutral of LT switchgear.

3.14 Neutral connections and metallic conduits/pipes shall not be used for the equipment earthing. Lightning protection system down conductors shall not be connected to other earthing conductors above the ground level.

3.15 Connections between earth leads and equipment shall normally be of bolted type. Contact surfaces shall be thoroughly cleaned before connections. Equipment bolted connections after being tested and checked shall be painted with anti corrosive paint/compound.

3.16 Resistance of the joint shall not be more than the resistance of the equivalent length of conductor.
3.17 A minimum earth coverage of 300 mm shall be provided between earth conductor and the bottom of trench/foundation/underground pipes at crossing. Earthing conductors crossing the road can be installed in hume pipes. Wherever earthing conductor crosses on runs at less than 300 mm distance along metallic structures such as air, water, pipe lines, steel reinforcement in concrete, it shall be bonded to the same.

3.18 Earthing conductors along their run on columns, walls, etc. shall be supported by suitable welding/cleating at interval of 1000 mm and 750 mm respectively.

3.19 On completion of installation, continuity of earth conductors and efficiency of all bonds and joints shall be checked. Earth resistance at earth termination shall be measured in presence of Purchaser’s representatives. Any equipment required for testing shall be furnished by Bidder.

3.20 **LIGHTNING PROTECTION SYSTEM**

Lightning protection system shall be in strict accordance with IS:2309.

3.20.1 Lightning masts shall be provided on any structure having height 15 metre or more. The height of the masts above its fixing point on the structure shall be 2 metre. The spacing between two adjacent masts shall not be less than 20 metre.

3.20.2 Lightning conductor shall be of 25 x 6 mm GS strip when used above ground level. It shall be connected through test link with earth electrode/earthing system.

3.20.3 The Bidder shall furnish the details including typical arrangement drawings for the lightning protection system offered.

3.20.4 a) Down conductors shall be as short and straight as practicable and shall follow a direct path to earth. Down conductor shall not be connected to other earthing conductors above ground level. The size of down conductor of each mast shall not be lower than 65 x 8 mm. Each down conductor shall be effectively connected to independent earthing pit.

b) Each down conductor shall be provided with a test link at 1000 mm above ground level for testing but it shall be in accessible to interference. No connections other than the one direct to an earth electrode shall be made below a test point.

c) All joints in the down conductors shall be of welded type.

d) Down conductors shall be cleated on outer side of building wall, at 750 mm interval or welded to outside building columns at 1000 mm interval.

e) Lightning conductor on roof shall not be directly cleated on surface. Supporting blocks of PCC/insulating material shall be used for conductor fixing.

3.20.5 a) All metallic structures within a vicinity of two meters of the conductors shall be bonded to conductors of lighting protection system.

b) The lightning protection system shall not be through cables, conduits and metal enclosures of electrical equipment.

c) Lightning conductors shall not pass through or run inside GI Conduits.

d) Testing link shall be made of galvanised steel of size 25 x 6 mm.
1.0 General

Three nos. of centralised welding circuits have been envisaged for Mahespur RLS project.

One circuit from Receiving Pit to Transfer House TP-I&II. The second from TP-I&II to Transfer House TP-III&IV and also along the Link conveyor and the third from TP-I&II up to and including the overhead silo. One number of motor generator set and two nos. transformer welding sets have been envisaged for each circuit, which shall be located as follows:

i) Near Receiving Pit for circuit no. 1.
ii) In between Transfer House TP-I&II and TP-III&IV circuit no. 2.
iii) In between TP-III&IV and the overhead silo

From these welding sets the respective welding circuit shall be fed in such a way that, the power for welding shall be available immediately after inserting the plug to the socket outlet with 50 metres length of extra welding cable. The Welding system shall be provided along the conveyor length and on each floor of crushing complex, transfer houses, reclaim tunnel etc. The Bidder shall give the quantity, location and specification of the socket cum switch in the offer. The location of socket shall be such as to facilitate welding at any point in the CHP complex.

The welding circuit shall have suitable metallic socket connection at suitable intervals to cover the complete area for which it is to be provided. While designing the welding circuits necessary consideration shall be taken to avoid voltage drop.

Each centralised welding system shall comprise of 3 nos. welding machines, 1 core PVC cable of suitable size in form of ring main for power and 75 mm x 6 mm MS Flat in form of earth bus around the area for which it is installed. Each ring main shall have adequate nos. of 1 pole, 300Amps socket outlet for direct connection of welding cable through plugs. Earthing connection of welding machine shall be connected to the earth ring main through insulated cable to avoid flow of welding current through structures, foundation bolts etc. Size of earth bus is tentative and subject to change during detail design stage.

2.0 Motor Generator Set

The Motor Generator set shall have squirrel cage induction motor. The control panels with dial shall be fixed on the top of the MG set. Complete welding set shall be mounted on a four wheel trolley with spring loaded handle for easy transportation. The motor shall be wound for 415 V ± 10%, 3 phase, 50 Hz AC supply system. The motor shall be provided with overload, single phasing, no-voltage and under voltage protection.

The generator shall have completely laminated magnetic circuit. It shall have
static excitation by means of bridge rectifier mounted on the control box. Provision shall be made for smooth and step-less adjustment of the welding current by means of current controlling rheostat.

The MG Set shall have welding current range of 80-320 Amps and it shall be complete with Star Delta Starter and conform to BS 638 and IS:2635. However the exact values of the currents shall be quoted by the bidder along with the offer. The Bidder shall enclose the list of equipment and accessories in the offer.

3.0 **Transformer welding set**

Air cooled single operator, aluminium wound arc welding transformers have been envisaged for welding system of the CHP complex. The transformers shall be suitable for 415 V ± 10%, 3 phase, 50 Hz AC supply system. The transformer shall be designed for output of approximate 80 Amps to 450 Amps at 80 volt open circuit and 180 Amps to 350 Amps at 100 volt open circuit covering an electrode range from 2.5 mm to 6 mm. However, the exact values of the range should be quoted by the Bidder in the offer. The welding set shall be provided with a current selector plate and a cable reel for winding up the welding cable when not in use. Provision shall be made for easy lifting of the welding sets.

4.0 The welding sets shall be complete with accessories like electrode and ground cables, electrode holder, earthing clamps, leather hand gloves and face shield with lens. The welding sets shall be located in welding transformer rooms of 2 x 3x 3 m each.
SPECIFICATION FOR LOCAL PUSH BUTTON STATION

The Local Control Stations (LCS) shall be metal enclosed, suitable for outdoor/indoor mounting on wall or steel structures. The enclosure shall be die-cast aluminium or cold rolled sheet steel of at least 1.6 mm thickness. The enclosure shall be provided with a hinged guard at the front, covering full length, to avoid inadvertent operation of pull chord switches/push buttons. LCS shall be painted to shade no. 692 of IS:5 in accordance with relevant code. The LCS shall be dust and vermin proof and shall have a degree of protection of IP-53 as per relevant code.

The LCS shall be suitable for both top and bottom cable entry (either of which may be used depending on cabling convenience) and shall be provided with removable undrilled gland plates or knockouts. Adequate space shall be available inside the LCS enclosure for terminating external cables directly on pull cord/push button terminals. Overall size of LCS shall be subject to Purchaser’s approval.

The Local Control Stations shall be of the following types:

Type A: comprising of latched type EMERGENCY STOP push button with one NO and one NC contact.

Type B: comprising of latched type EMERGENCY STOP pull cord switch and a self reset START push button with one NO and one NC contact.

Type C: same as Type B except that each push button shall have two NO and two NC contacts.

Type D: comprising a self reset “Trial Run” and a self reset “Trial Stop” push button each with one NO and one NC contact. Alternatively, the LCS may be provided with a “LOCAL” & “REMOTE” selector switch.
SPECIFICATION FOR LOCAL MOTOR STARTER

The Local Motor Starters shall be provided for manual switching of 440 V, 3 phase, squirrel cage motors

The starters shall be metal enclosed, suitable for outdoor/indoor mounting on wall or steel structures. The enclosure shall be die-cast aluminium or cold rolled sheet steel of at least 1.6 mm thickness. The enclosure shall be provided with a hinged guard at the front, covering full length, to avoid inadvertent operation of push buttons. The starters shall be painted to shade no. 692 of IS:5 in accordance with relevant code and shall be dust and vermin proof and shall have a degree of protection of IP-52 or per relevant code.

The Starters shall be suitable for both top and bottom cable entry (either of which may be used depending on cabling convenience) and shall be provided with removable undrilled gland plates or knockouts. Adequate space shall be available inside the starter enclosure for terminating external cables directly on push button terminals. Overall size of Starters shall be subject to Purchaser's approval.

Each Starter shall comprise of:

i)  A 3-pole contactor, mechanically latched type
ii) Start Push Button, colored GREEN
iii) Stop Push Button, colored RED
iv) Ambient temperature compensated thermal overload relay with single phasing protection. The continuously variable relay setting range shall be suitable for the motor rating.

The start push button when pressed, shall preferably remain in depressed position and shall be released along the contactor when the stop push button is pressed or when thermal overload relay operates. Local starters shall be suitable for loop-in and loop-out of incoming cable and for one outgoing cable to a motor.
SPECIFICATION FOR MAIN LIGHTING DISTRIBUTION BOARDs (M.L.D.B.)

1.0 SCOPE

This specification covers requirements for 440V MLDBs, metal enclosed, dust and vermin proof to be installed in substations, conforming to the latest revision of IS:8623-1993 except where modified or extended by the provision of this specification.

2.0 OTHER RELEVANT STANDARDS

The other relevant Indian standards are as under:


Where Indian standards are not available International standards like British standards, ISO, DIN, JIS or Other standards which ensures performance equivalent or superior to Indian standard shall be followed.

The equipment covered under this specification shall comply with all the latest applicable statutory rules, regulations, acts and safety codes which may be in force during the period of execution and which are related with design, construction and operation of equipment in the locality where the equipment is to be installed.

Nothing in this specification shall be construed as to relieve the supplier of the responsibility for correctness of the design and construction of the equipment.

All the standards being followed shall be listed out in the bid. Where any foreign standard is being followed, the copy of the same shall be provided with the bid.

Wherever service conditions and requirements laid down in this specification differ from applicable standards, the conditions specified herein shall prevail.

3.0 SERVICE CONDITIONS

<table>
<thead>
<tr>
<th>Condition</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient air temperature</td>
<td>5°C to 50°C</td>
</tr>
<tr>
<td>Altitude</td>
<td>Maximum up to 1000 M above MSL.</td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>Approximately 97 %.</td>
</tr>
<tr>
<td>Pollution degree</td>
<td>Degree 4 as per IS : 13947 (Part I)</td>
</tr>
<tr>
<td></td>
<td>(i.e. the pollution generates persistent conductivity caused by conductive dust)</td>
</tr>
</tbody>
</table>
4.0 DESIGN CRITERIA

The boards shall operate on a 440V (± 6%), 3 phase, 3 wire, 50 Hz (-5% to 3%) power supply. Fault withstand capacity shall not be less than 10 kA for one second.

The boards shall have power frequency withstand voltage of 3000V. All similar components shall be interchangeable and shall be of same type and rating for maintenance and low spare inventory.

5.0 CONSTRUCTIONAL FEATURES

5.1 The boards shall be made of two modular standard vertical sections, extendible on either side. Each vertical section shall be made of sheet steel enclosures on steel frames. The thickness of steel sheets shall be 2 mm for load bearing sections and 1.6 mm for non-load bearing sections.

5.2 The vertical sections shall be single front type and of two tier formation.

5.3 Degree of protection of the enclosure shall be IP 43 with coats of paints conforming to IS : 5.

5.4 The bus bars shall be TP, Aluminium and of adequate current rating for horizontal and vertical bus. The bus bars shall be mounted on non hygroscopic, anti tracking, flame retardant, self extinguishing insulators. The bus bars shall be PVC insulated (sleeved).

5.5 The cable termination for cable sizes within 70 mm shall be inside each 2 vertical section. For sizes above 70 mm, the termination shall be in a cable chamber extended type. All the cable entries shall be from bottom.

5.6 The earth bus bar shall be of minimum 90 mm Aluminium.

5.7 One MLDB each has been envisaged. MLDBs located at Switching station shall receive power from lighting transformers located at the switching station, whereas, MLDB located at MCC-III shall receive power from lighting transformer at MCC-III.

The specification for MCCB, MCB, Switchfuse units etc. are given in subsequent clauses in this specification.

5.8 The board shall have a mechanical safety door interlock device to prevent opening of the door if the switches are ON. Similarly, it shall be ensured that the switch cannot be switched ON unless the door is closed. There shall also be padlocking arrangement for the door to prevent unauthorised access.

5.9 The MCCBs, Horizontal bus bars, extended chambers and the MCBs shall be in separate compartments.

5.10 ON/OFF switches of the MCCBs and MCBs and knobs of Ammeters shall be protruded for operation without opening the doors.

5.11 The incoming feeders shall be provided with Ammeters with selector switches.

5.12 The boards shall have a display of Danger Notice and supply shall be made with front rubber mat.
ANNEXURE - I

TECHNICAL SPECIFICATION FOR 440 V MLDB

1. Installation : Indoor
2. Enclosure : Single front, IP 43
3. Rated voltage : 440 V
4. Bus bar : TPN (Aluminium)
5. Horizontal bus bar rating : Adequate Rating
6. Vertical bus bar rating : Adequate Rating
7. Short time rating : 13.1 kA rms for 1 second
8. Withstand voltage : 3000 V, 50 Hz, 1 min.
9. Cable termination : Cable chamber
10. Cable types : Three core PVCSWA (Al.) conductor
11. Cable entry : Bottom
12. Size of earth bus : 2 90 mm Aluminium (minimum)
15. Finish : Two coats of primer and one coat of final paint as per IS : 5.
6.0 SPECIFICATION FOR MOULDED CASE CIRCUIT BREAKERS  SP/E - 18

6.1 SCOPE
This specification covers requirements for 440V Moulded Case Circuit Breakers suitable for installation in switchboards (MLDB).

The Moulded case circuit breakers shall comply with the latest revision of IS: 13947(Part I) and IEC: Publication 947 except where modified or extended by the provision of this specification and with the relevant parts of standards mentioned in clause 6.2.

Any material and component not specifically stated in this specification but necessary for trouble free operation of the equipment and accessories specified herein shall deemed to be included.

6.2 OTHER RELEVANT STANDARDS
The other relevant Indian standards are as under :
IS : 3072 : Code of practice for installation and maintenance of switchgear.
IS : 4237 : General requirements for switchgear and controlgears for voltages not exceeding 1000V AC.
IS : 10118 : Code of practice for selection, installation and maintenance of Switchgear and Controlgear.
IS : 11353 : Guide for uniform system of marking and identification of conductors and apparatus terminals.

Where Indian standards are not available International standards like British standards, ISO, DIN, JIS or Other standards which ensures performance equivalent or superior to Indian standard shall be followed.

The equipment covered under this specification shall comply with all the latest applicable statutory rules, regulations, acts and safety codes which may be in force during the period of execution and which are related with design, construction and operation of equipment in the locality where the equipment is to be installed.

Nothing in this specification shall be construed as to relieve the supplier of the responsibility for correctness of the design and construction of the equipment.

All the standards being followed shall be listed out in the bid. Where any foreign standard is being followed, the copy of the same shall be provided with the bid.

Wherever service conditions and requirements laid down in this specification differ from applicable standards, the conditions specified herein shall prevail.

6.3 DESIGN CRITERIA
The Moulded Case Circuit Breakers shall operate on a 440V (+ 6%), 3 phase, 50 Hz (-5% to +3%) power supply. Fault withstand capacity shall not be less than 10 kA.
All similar components shall be interchangeable and shall be of same type and rating for easy maintenance and low spare inventory.

The rated carrying capacity shall be sufficient at the rated voltage and frequency and the circuit breaker shall carry this current continuously while complying with this specification.

6.4 CONSTRUCTIONAL FEATURES

1) The Circuit breakers shall be three pole, moulded case air break type.

2) The circuit breaker shall have tripping mechanism for over load and short circuit irrespective of the type of operating mechanism. In addition, provision shall be made for manual tripping of the breaker. The breakers shall be fixed type.

3) Circuit Breaker shall be provided with anti-pumping and trip free feature.

4) Tripping shall be possible by means of front mounted "OFF" switch. Making of the breaker shall be possible by means of "ON" switch.

5) Suitable arc splitters and magnetic blowouts and chutes shall be provided for efficient arc extinction of high as well as low values of interrupting currents.

6) Suitable indications shall be provided on circuit breaker to show "ON", "OFF", conditions.

7) The following protection (release type) shall be provided:
   a) Ambient temperature compensated thermal overload trip with adjustable settings.
   b) Magnetic Short circuit trip.

6.5 PERFORMANCE

1) The temperature rise of parts of the equipment like terminals, accessible parts, main circuit, windings of coils and electromagnets etc. measured during the test carried out in accordance with IS: 13947 (Part I) shall not exceed temperature rise limits specified in the said standard.

2) The dielectric property of the equipment shall conform to co-ordination of insulation related to insulation levels indicated in IS: 13947 (Part I).

3) Clearances shall be sufficient to enable the equipment to withstand the rated withstand voltage as indicated in the IS: 13947 (Part I).

4) The minimum creepage distance shall be as per IS: 13947 (Part I).

5) The equipment shall be capable of making and breaking load and overload currents without failure under the conditions stated in the relevant product standard for the required utilisation category.

6) The equipment shall be capable of withstanding thermal and electromagnetic stress from short circuit currents during current making, current carrying in the closed position and during current interruptions.
6.6 **NAME PLATE**

The name plates of the circuit breaker shall have suitable marking as under:
- Manufacturer
- Type designation and serial number
- Rated voltage
- Rated current
- Rated frequency
- Short circuit withstand capacity
- Short circuit breaking capacity
- Weight
- Year of manufacture

6.7 **TEST CERTIFICATE**

The bidder shall supply at the time of execution the routine test certificates from the manufacturer indicating the type of tests conducted, the test results and the serial nos. of the breakers which shall also appear in the Name Plate of each breaker.
### TECHNICAL SPECIFICATION FOR 440 V MOULDED CASE CIRCUIT BREAKERS

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong></td>
<td>Installation</td>
<td>: Switch board</td>
</tr>
<tr>
<td><strong>2</strong></td>
<td>Number of Poles</td>
<td>: 3</td>
</tr>
<tr>
<td><strong>3</strong></td>
<td>Service Voltage</td>
<td>: 440 V (+ 6%)</td>
</tr>
<tr>
<td><strong>4</strong></td>
<td>Rated current (A)</td>
<td>: 630A/500A/400A/315A/250A/200A/160A/125A/100A</td>
</tr>
<tr>
<td><strong>5</strong></td>
<td>Making capacity</td>
<td>: 25 kA (peak)</td>
</tr>
<tr>
<td><strong>6</strong></td>
<td>Frequency</td>
<td>: 50 Hz (-5% to 3%)</td>
</tr>
<tr>
<td><strong>7</strong></td>
<td>Symmetrical breaking capacity</td>
<td>: 10 kA (rms)</td>
</tr>
<tr>
<td><strong>8</strong></td>
<td>Short time current for 1 Second</td>
<td>: 10 kA (rms)</td>
</tr>
</tbody>
</table>
| **9** | Settings | : Thermal (Adjustable)  
Magnetic 9 kA |
| **10** | Operating Mechanism | : Manual Trip free |
| **11** | Tripping arrangement | : Thermal overload and Short circuit electromagnetic release. |
| **12** | Protections to be provided | : i) Short circuit  
ii) Overload |
| **13** | Cable Entries | : Suitable for PVCSWA with Aluminium conductor, Totally shrouded to avoid risk of electric shock to operating personnel. |
| **14** | Execution | : Fixed |
7.0 **SPECIFICATION FOR 440V/230 V MINIATURE CIRCUIT BREAKERS SCOPE**

This specification covers requirements for 440V/230 V Miniature Circuit Breakers suitable for installation in switchboards (MLDBs).

The Miniature circuit breakers shall comply with the latest revision of IS:8828-1993 except where modified or extended by the provision of this specification and with the relevant parts of standards mentioned in clause 7.2.

Any material and component not specifically stated in this specification but necessary for trouble free operation of the equipment and accessories specified herein shall deemed to be included.

7.2 **OTHER RELEVANT STANDARDS**

The other relevant Indian standards are as under:

<table>
<thead>
<tr>
<th>IS</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS : 3072</td>
<td>Code of practice for Installation and Maintenance of switchgear.</td>
</tr>
<tr>
<td>IS : 4237</td>
<td>General requirements for switchgear and controlgears for voltages not exceeding 1000V AC.</td>
</tr>
<tr>
<td>IS : 10118</td>
<td>Code of practice for selection, installation and maintenance of Switchgear and Controlgear.</td>
</tr>
<tr>
<td>IS : 11353</td>
<td>Guide for uniform system of marking and identification of conductors and apparatus terminals.</td>
</tr>
</tbody>
</table>

Where Indian standards are not available International standards like ISO, DIN, JIS or Other standards which ensures performance equivalent or superior to Indian standard shall be followed.

The equipment covered under this specification shall comply with all the latest applicable statutory rules, regulations, acts and safety codes which may be in force during the period of execution and which are related with design, construction and operation of equipment in the locality where the equipment is to be installed.

Nothing in this specification shall be construed as to relieve the supplier of the responsibility for correctness of the design and construction of the equipment.

All the standards being followed shall be listed out in the bid. Where any foreign standard is being followed, the copy of the same shall be provided with the bid.

Wherever service conditions and requirements laid down in this specification differ from applicable standards, the conditions specified herein shall prevail.
7.3 DESIGN CRITERIA

The breakers shall operate on a 440V/230V (± 6%), 2 phase, 50 Hz (-5% to 3%) power supply. Fault withstand capacity shall not be less than 9 kA for one second.

The rated carrying capacity shall be as specified in Annexure IB at the rated voltage and frequency and the breaker shall carry this current continuously while complying with this specification.

7.4 CONSTRUCTIONAL FEATURES

1) General
The miniature circuit breakers shall have IP-43 protection.

2) Miniature Circuit Breakers

h) The circuit breaker shall have current limiting devices with an inverse time delayed thermal trip device and an undelayed magnetic trip device to take care of steady overload and short circuit faults respectively. The breakers should be suitable for switching/ protection of lighting circuits.

ii) The technical data for Circuit breakers are given in Annexure-IB.
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Application</td>
<td>Switch board</td>
</tr>
<tr>
<td>2</td>
<td>Number of poles</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Breaking capacity</td>
<td>10kA (rms)/9 kA for 1 second</td>
</tr>
<tr>
<td>5</td>
<td>Rated voltage</td>
<td>440V/230V (+6%)</td>
</tr>
<tr>
<td>6</td>
<td>Frequency</td>
<td>50 Hz (-5% to 3%)</td>
</tr>
<tr>
<td>7</td>
<td>Enclosure of the breakers</td>
<td>Moulded self extinguishing thermoset plastic.</td>
</tr>
<tr>
<td>8</td>
<td>Dolly (Switching lever)</td>
<td>Can be locked in either OFF or ON position.</td>
</tr>
<tr>
<td>9</td>
<td>Fixing</td>
<td>Snap fitting</td>
</tr>
<tr>
<td>10</td>
<td>Terminals</td>
<td>To take PVCSWA 25 mm² conductors for the outgoing cables. Incoming terminals shall be connected to bus.</td>
</tr>
<tr>
<td>11</td>
<td>Mechanical service life</td>
<td>Not less than 20,000 operations.</td>
</tr>
<tr>
<td>12</td>
<td>Electrical endurance at rated load</td>
<td>Not less than 20,000 operations.</td>
</tr>
<tr>
<td>13</td>
<td>Climate resistance to confirm requirements of</td>
<td>IEC - 68/2</td>
</tr>
<tr>
<td>14</td>
<td>Ambient temperature</td>
<td>As mentioned in para 3.0</td>
</tr>
<tr>
<td>15</td>
<td>Operating mechanism</td>
<td>Manual Trip Free</td>
</tr>
</tbody>
</table>
8.0 SPECIFICATION FOR 230V SWITCH FUSE UNIT SP/E -20

8.1 SCOPE

This specification covers requirements for 440V/230V Switch Fuse Units conforming to IS:13947 (Part 3) inclusive of latest amendments, if any. Any material and component not specifically stated in this specification but necessary for trouble free operation of the equipment and accessories specified herein shall be deemed to be included.

8.2 DESIGN CRITERIA

The switches shall operate on a 440V/230V (+6%), 2 phase, 50 Hz (-5% to 3%) power supply. Fault withstand capacity shall be not less than 9 kA for one second.

The rated current carrying capacity shall be as specified in Annexure IC at the rated voltage and frequency and the switch shall carry this current continuously while complying with this specification.

8.3 CONSTRUCTIONAL DETAILS

The switches shall be made of two pole, silver tipped copper contacts with steel springs for rapid movement during changeover. The unit shall have suitable interlock type having interlock with switch board door.

The enclosure shall be of steel sheets 1.6 mm thick with aesthetic finish and final coats of paints.
### ANNEXURE IC

**TECHNICAL SPECIFICATION FOR SWITCH FUSE UNIT**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Installation</td>
<td>: Switch board</td>
</tr>
<tr>
<td>2</td>
<td>No. of Poles</td>
<td>: 4/2</td>
</tr>
<tr>
<td>3</td>
<td>Service Voltage</td>
<td>: 440V/230V (± 6%)</td>
</tr>
<tr>
<td>4</td>
<td>Continuous current</td>
<td>: 250A, 200A, 125A, 63A &amp; 32A</td>
</tr>
<tr>
<td>5</td>
<td>Nominal short time current</td>
<td>: 10 kA (rms)/9 kA</td>
</tr>
<tr>
<td>6</td>
<td>Contactor Duty</td>
<td>: AC 1</td>
</tr>
<tr>
<td>7</td>
<td>Frequency</td>
<td>: 50 Hz (-5% to 3%)</td>
</tr>
<tr>
<td>8</td>
<td>Mechanical life</td>
<td>: Not less than 3 Million operations.</td>
</tr>
<tr>
<td>9</td>
<td>Safety interlock</td>
<td>: As mentioned in para 5.8</td>
</tr>
<tr>
<td>10</td>
<td>Enclosure</td>
<td>: Sheet Steel 1.6 mm.</td>
</tr>
</tbody>
</table>
SPECIFICATION FOR 230V LIGHTING DISTRIBUTION BOARD

1.0 SCOPE
This specification covers requirements for 230V Miniature and/or Residual Current Circuit Breaker suitable for installation in a switchboard (LDB).

The Miniature-Residual Current circuit breaker shall comply with the latest revision of IS : 8828 and the associated switch board shall conform to IS : 8623 with the relevant parts of standards mentioned in clause 2.0 except where modified or extended by the provision of this specification.

Any material and component not specifically stated in this specification but necessary for trouble free operation of the equipment and accessories specified herein shall deemed to be included.

2.0 OTHER RELEVANT STANDARDS
The other relevant Indian standards are as under:

IS : 3043 : Code of practices for earthing.
IS : 4237 : General requirements for switchgear and control gears for voltages not exceeding 1000V AC.
IS : 10118 : Code of practice for selection, installation and maintenance of Switchgear and Control gear.
IS : 11353 : Guide for uniform system of marking and identification of conductors and apparatus terminals.
IS : 8588 : Thermostatic bimetals.

In case equipments conforming to other standards like BS, DIN, VDE, ANSI, JIS or other standards are offered the same shall be considered if these ensure performance equivalent or superior to Indian standards.

The equipment covered under this specification shall comply with all the latest applicable statutory rules, regulations, acts and safety codes which may be in force during the period of execution and which are related with design, construction and operation of equipment in the locality where the equipment is to be installed.

Nothing in this specification shall be construed as to relieve the supplier of the responsibility for correctness of the design and construction of the equipment. All the standards being followed shall be listed out in the bid. Where any foreign standard is being followed, the copy of the same shall be provided with the bid.

Wherever service conditions and requirements laid down in this specification differ from applicable standards, the conditions specified herein shall prevail.
3.0 **SERVICE CONDITIONS**

- **Ambient temperature**: Maximum 50\(^0\) C.
- **Altitude**: Upto 1000 M above MSL.
- **Relative Humidity**: Approximately 97 %.
- **Pollution degree**: Degree 4 as per IS : 13947 (Part I) (i.e. the pollution generates persistent conductivity caused by conductive dust)

4.0 **CONSTRUCTION**

4.1 **General**

The miniature circuit breakers shall be suitable for mounting in 4 ways/8 ways/12 ways/16 ways distribution boards with IP-42 protection.

4.2 **Enclosure**

The enclosure shall be manufactured from at least 2 mm thick steel sheets in aesthetically appealing powder coated finish. The boards are to confirm to the requirement of IS : 8623 for factory built assemblies.

**Bus bar system**

3.3 **22 least cable sizes of 25 mm for phase conductors and 16 mm for neutral**

The bus bar system should incorporate integral single piece bar and coupling links to avoid chances of hot spot developing as is possible with bolted construction of bus bar and links. The bus bar system should accept triple pole, double pole and single pole circuit breakers in any combination of these. The bus bars should be shrouded against accidental contact. The circuit breakers should be arranged in two horizontal or vertical banks with switch levers operating in vertical or horizontal planes for on-off switching. The mounting of breakers should be quick snap and easy removal type without disturbing the other breakers. It should be capable of being connected to at least cable sizes of 22-25 mm for phase conductors and 16 mm for neutral conductors. Two conduit entry plates at the top and the bottom should facilitate drilling of holes at site to suit individual requirements.

4.4 **Miniature/Residual Current Circuit Breakers and Distribution Boards**

4.4.1 These breakers shall be current limiting devices with an inverse time delayed thermal trip device and an undelayed magnetic trip device to take care of steady overload and short circuit and earth leakage faults respectively. The breakers shall be suitable for switching/control/protection/regulation of lighting, control and motor circuits.

4.4.2 The circuit breakers should also be suitable for protection/control/switching of single phase, 230 Volt motors.

4.4.3 The technical data for Circuit breakers are given in Annexure-IA.

4.4.4 The technical data for Distribution Boards are given in Annexure-IB.
## TECHNICAL SPECIFICATION FOR MINIATURE /RESIDUAL CURRENT CIRCUIT BREAKERS

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Applicable standard : IS 8828</td>
</tr>
<tr>
<td>2</td>
<td>Number of poles : 2 for incoming MCB and RCCB if any. 2 for outgoing for MCB.</td>
</tr>
<tr>
<td>3</td>
<td>Rated Current : 0.5/1/5/10/16/25/32/40/63 A</td>
</tr>
<tr>
<td>4</td>
<td>Breaking capacity : 9 kA</td>
</tr>
<tr>
<td>5</td>
<td>Rated voltage : 230 V for DP</td>
</tr>
<tr>
<td>6</td>
<td>Frequency : 50 Hz</td>
</tr>
<tr>
<td>7</td>
<td>Enclosure of the breakers : Moulded self extinguishing thermo set plastic.</td>
</tr>
<tr>
<td>8</td>
<td>Dolly (Switching lever) : Can be locked in either (Off or On position).</td>
</tr>
<tr>
<td>9</td>
<td>Auxiliary contact poles (for control circuits, if any) Fixing : 230V 5A, A.C. (Optional).</td>
</tr>
<tr>
<td>10</td>
<td>Snap fitting</td>
</tr>
<tr>
<td>11</td>
<td>Terminals : 25 mm conductors for phase and 16 mm for neutral.</td>
</tr>
<tr>
<td>12</td>
<td>Mechanical service life : Not less than 20,000 operations.</td>
</tr>
<tr>
<td>13</td>
<td>Electrical endurance at rated load : Not less than 20,000 operations.</td>
</tr>
<tr>
<td>14</td>
<td>Climate resistance to conform requirements of : IEC - 68/2</td>
</tr>
<tr>
<td>15</td>
<td>Ambient temperature : As mentioned in para 3.0</td>
</tr>
</tbody>
</table>
### TECHNICAL SPECIFICATION FOR DISTRIBUTION BOARDS

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Applicable Standard</td>
<td>IS : 8623</td>
</tr>
<tr>
<td>2</td>
<td>Bus current carrying capacity</td>
<td>Suitable with DP</td>
</tr>
<tr>
<td>3</td>
<td>Enclosure</td>
<td>2 mm thick CRCA sheets.</td>
</tr>
<tr>
<td>4</td>
<td>No. of outgoings</td>
<td>4 ways / 8 ways / 12 ways / 16 ways.</td>
</tr>
<tr>
<td>5</td>
<td>No. of incoming</td>
<td>1 No.</td>
</tr>
<tr>
<td>6</td>
<td>Mounting</td>
<td>Channel mounted / Flush top cover.</td>
</tr>
<tr>
<td>7</td>
<td>Cable entry</td>
<td>Top / Bottom cable entry conduits.</td>
</tr>
<tr>
<td>8</td>
<td>Protection</td>
<td>IP 42 (Metallic double door) degree of protection.</td>
</tr>
<tr>
<td>9</td>
<td>Finishing</td>
<td>Powder coated finish.</td>
</tr>
<tr>
<td>10</td>
<td>Locking</td>
<td>Pad locking facility.</td>
</tr>
<tr>
<td>11</td>
<td>Bus bar</td>
<td>Shrouded type integral single piece bus bar.</td>
</tr>
<tr>
<td>12</td>
<td>Arrangement of breakers</td>
<td>Vertical/Horizontal arrays.</td>
</tr>
</tbody>
</table>
1.0 SPECIFICATION FOR SWITCH BOARDS FOR LIGHTING CIRCUITS

1.0 SCOPE:

This covers requirements for switch boards for tube light & fan circuits.

2.0 CODES:

The applicable codes are as under:

- IS : 1293 3-Pin, plug and socket outlets
- IS : 3954 Switches for domestic and similar purposes
- IS : 694 PVC unarmoured 660 V grade cable
- IS : 5133 Boxes for enclosure of electrical accessories - Steel and cast iron boxes
- IS : 9224 Low voltage fuses

3.0 CONSTRUCTION:

3.1 Switch Boards

i) The switch boards shall be made of 1.6 mm thick, MS sheet with 3 mm, thick decorative, bakelite cover. The switch boards shall be hot dip galvanised and provided with earthing terminal, mounting holes and screws, specified number of conduit knock outs on both the sides etc. The switch boards shall be suitable for surface mounting. The switchboards shall mount Double pole MCBs and sockets.

ii) The switches shall be Double pole MCBs, quick make quick break suitable for operation on 230 V AC supply.

iii) The sockets shall be of 5 pin type 5/15 A, 230 V AC socket with 15 A switch.

iv) The switch boards shall be adequately sized to accommodate switches/fan regulators/sockets. All switch boards mounted items shall be fully wired by 660 V grade PVC insulated flexible Copper wire.

v) All in-coming and out-going wires shall be suitable for loop in loop out of 4 Sq. mm stranded Aluminium wire and tap off of 1.5 Sq. MM copper wire.
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Rated Voltage : 230 V</td>
</tr>
<tr>
<td>2.</td>
<td>No of 5A Double pole MCBs : As required</td>
</tr>
<tr>
<td>3.</td>
<td>No of 5/15A, 3/5 pin socket with 16A MCBs : As required</td>
</tr>
<tr>
<td>4.</td>
<td>No of fan regulators (electronic) : As required</td>
</tr>
<tr>
<td>5.</td>
<td>Rewirable fuse 5A with base : As required</td>
</tr>
<tr>
<td>6.</td>
<td>Top cover : Decorative Bakelite 3 mm thick</td>
</tr>
<tr>
<td>7.</td>
<td>Switch board : 1.6 mm thick MS sheet</td>
</tr>
<tr>
<td>8.</td>
<td>Internal wiring : with 660 V grade by 1.5 Sq mm Copper cable</td>
</tr>
<tr>
<td>9.</td>
<td>Mounting : Flush/projected</td>
</tr>
<tr>
<td>10.</td>
<td>Earthing : Two terminals shall be provided for earthing by 8 SWG GI Wire</td>
</tr>
</tbody>
</table>
SPECIFICATION FOR LAMP FIXTURES

1.0  **SCOPE**

1.1 This specification covers requirement for fixtures of tubular and compact fluorescent lamps, sodium and mercury vapor lamps & tungsten lamps in various applications.

1.2 The fixtures shall comply with the latest revision of IS:1913, IS:3287, IS:4013, IS:1777 & IS:10322 except where modified or extended by the provision of this specification and with the relevant parts of standards mentioned in clause 2.0.

1.3 Any material, component or accessory not specifically stated in this specification but necessary for trouble free operation shall deemed to be included.

2.0  **OTHER RELEVANT STANDARDS**

2.1 The other standards applicable are as under:

<table>
<thead>
<tr>
<th>IS</th>
<th>Standard Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1534</td>
<td>Ballasts for fluorescent lamps for switch start circuits</td>
</tr>
<tr>
<td>6616</td>
<td>Ballasts for high pressure mercury vapour lamps</td>
</tr>
<tr>
<td>1569</td>
<td>Capacitors for use in tubular fluorescent and high pressure Vapour discharge lamp circuits</td>
</tr>
<tr>
<td>2215</td>
<td>Starters for fluorescent lamps</td>
</tr>
<tr>
<td>3323</td>
<td>Bi Pin lamp holders for tubular fluorescent lamps</td>
</tr>
<tr>
<td>7569</td>
<td>Case acrylic sheets for use in luminaries</td>
</tr>
<tr>
<td>8913</td>
<td>Methods of measurement of lamp cap. temperature rise</td>
</tr>
<tr>
<td>10276</td>
<td>Edison Screw lamp holders</td>
</tr>
<tr>
<td>3043</td>
<td>Code of practice for earthing</td>
</tr>
</tbody>
</table>

3.0  **CONSTRUCTION**

3.1 All lighting fixtures shall be complete with lamp holder, control gear, reflector and cable gland. Power Factor of the fixtures shall be not less than 0.96. Suitable p.f. correction capacitor shall be provided wherever required.

3.2  **Fluorescent lamp fixtures**

3.2.1 The single tube economy type fixtures of the batten type shall be made of M.S. sheet finished in white stove enamel suitable for direct fixing to wall or ceiling. The unit shall be complete with electronic ballast, starter and lamp holders with end covers.

3.2.2 The single/twin tube commercial type fixtures of the channel type shall be made of cold rolled cold annealed (C.R.C.A.) M.S. sheets finished in white/grey stove enamel suitable for direct fixing to wall or suspended from ceiling. The unit shall be complete with electronic ballast, p.f. correction capacitor, starter and rotor locking type lamp holders with end covers.

3.2.3 The twin tube decorative type fixtures with louvers of the hexagonal pattern shall be supplied on a channel type fixture mentioned in para 3.2.2. The louvers moulded in white thermoplastic compound shall be supported below the channel by means of white stove enamelled metallic side panels and black stove enamelled metallic end plates. The unit shall be complete with electronic ballast, p.f. correction capacitor, starter and rotor locking type lamp holders with end covers.
holders.

3.2.4 The single/twin decorative tube fixtures with diffusers shall be extruded in opal thermoplastic compound and supported in black end plates. The diffuser shall be supplied on a channel type fixture mentioned in para 3.2.2. The unit shall be complete with electronic ballast, p.f. correction capacitor, starter and rotor locking type lamp holders.

3.2.5 The twin tube recessed fixture with louvers shall be made in a single piece moulding in white thermoplastic compound. The moulding shall be carried in a single piece sheet steel housing wired completely with electronic ballast, p.f. correction capacitor, starter and lamp holders. The fitting shall be designed for recessing into false ceiling and provided with a flange on all sides to ensure flush mounting. The fixture shall be finished in high Quality stove enameled white/grey outside and white inside. The louver shall be removable by tilting and lowering when carrying out lamp replacement.

3.2.6 The twin tube recessed fixtures with opal diffuser shall be made in an opal acrylic diffusing panel. The panel shall be carried in a single piece sheet steel housing wired completely with electronic ballast, pf. correction capacitor, starter and lamp holders. The fitting shall be designed for recessing into false ceiling and provided with a flange on all sides to ensure flush mounting. The fixture shall be finished in high Quality stove enameled white/grey outside and white inside. The diffuser panel shall be easily removable for carrying out lamp replacement.

3.3 High bay/ Medium bay fixtures for Vapor lamps.

3.3.1 The reflector shall be made of cast aluminium anodised and electrochemically treated for brightness to give a concentrated light distribution.

3.3.2 The control gear shall comprise ballasts, p.f. correction capacitors, ignitor. The control gear shall be housed adjacent to lamp holder housing. The lamp holder housing shall have radial cooling fins for efficient heat dissipation.

3.3.3 Heat resistant gasket or suitable arrangement shall be provided between the toughened glass and the reflector, between the lamp holder housing and the reflector and between the top canopy and the control gear housing.

3.3.4 The reflector shall be attached to the lamp holder housing by slotted/adjustable strips for lowering/raising to carry out re-lamping.

3.3.5 A cable gland shall be provided on the side of the canopy.

3.3.6 The fixture shall be suspended by means of a suspension hook in the top of the canopy. No chain suspension is acceptable.

3.3.7 The fixture shall be suitable for 1000 W HPMV lamp or 400 W HPSV lamp.

3.4 Highbay/ Medium bay fixtures for emergency lighting

3.4.1 The reflector shall be made of cast aluminium anodised

3.4.2 The fixture shall be suitable for 500 Watt tungsten G.L.S. lamps

3.4.3 The top canopy and the lamp holder shall be made of cast aluminium

3.4.4 The cable entry shall be on the side of the canopy

3.4.5 The fixture shall be suspended by means of a suspension hook in the top of the canopy. No chain suspension is acceptable.
3.5 Industrial Weather proof/Well Glass/bulk head fixtures for conveyor
Gantry lighting and other areas

3.5.1 The fixtures shall be a single piece aluminium body finished in stove enamel
grey outside and white inside

3.5.2 The unit shall be supplied with a frosted glass, synthetic rubber gasket and a
lamp holder for 70 Watt HPSV lamps.

3.6 Flood light fixtures

3.6.1 The reflector shall be made of cast aluminium anodised and electrochemically
treated for brightness and of parabolic shape to give a long beam throw.

3.6.2 A toughened front glass shall be sealed into the front of the fixture body with a
heat resistant

3.6.3 The fixture shall be suitable for 1000/400 Watt HPSV lamp or 1000 W halogen
lamp. The replacement of the lamp shall be done by opening a door/opening
at the back of the fixture body.

3.6.4 The cable entry gland shall be fitted to the lamp holder housing

3.6.5 A graduated disc shall be provided to enable adjustment in the spinning angle
of the fixture after mounting the fixture on a bracket.

3.6.6 The fixture shall be mounted on a bracket

3.7 Street light fixtures

3.7.1 The reflector shall be made of two cast aluminium anodised surfaces one on
either side.

3.7.2 A heat resistant prismatic bowl refractor shall be mounted on the reflector held
with a metal ring attached to the canopy by hinge and toggle catches.

3.7.3 The fixture incorporating reflector, control gear housing, lamp holder, terminal
block shall be made of one piece aluminium sheet deep drawn and finished
silver grey to resist corrosion.

3.7.4 The cable entry shall be from the side

3.7.5 A locking device shall be provided to prevent unauthorised opening of the
fixture.

3.7.6 The fixture shall be suitable for mounting 70 Watt/80 Watt/125 Watt/250 Watt/
400 Watt lamps.

3.8 Street light fixtures for fluorescent lamp

3.8.1 The canopy shall be fabricated from aluminium sheets finished in gray
shoving enamel.

3.8.2 The control gear shall comprise p.f. correction capacitor, electronic ballast and
starters

3.8.3 The control gear and the lamp holder shall be internally wired to a terminal
block.

3.8.4 A transparent bowl moulded from acrylic sheet shall be filled rigidly against a
heat resistant rubber gasket fixed to the canopy by suitable means making the
fixture dust & water proof.

3.8.5 The fixture shall be suitable for mounting on cantilevers having outside
diameter 50 mm.
3.8.6 The fixture shall be suitable for Single/Twin tubes

3.9 Post top fixtures for Mercury Vapour lamps

3.9.1 A cast aluminium spigot cap shall carry an opal acrylic bowl secured to it by screws.

3.9.2 This spigot cap shall also carry the lamp holder and a bridge piece supported on two pillars.

3.9.3 An aluminium canopy shall be fixed to the bridge piece by screw to make the whole fixture totally enclosed.

3.9.4 For fixtures with mercury vapor lamps, the control gear comprising choke, igniter and p.f. correction capacitor shall be housed in aluminium canopy.

3.9.5 The fixture shall also be suitable for 80 Watt/125 Watt mercury vapour lamp.

3.10 Street light fixture for low pressure sodium vapour lamps

3.10.1 The reflector shall comprise two electrochemically brightened and anodised aluminium reflectors of curved sections.

3.10.2 The reflector unit shall be housed inside cast aluminium canopy. The canopy shall be curved to give full length support to the reflectors.

3.10.3 The reflector shall be totally enclosed by an acrylic bowl scaled on a heat resistant rubber gasket.

3.10.4 All control gear components, i.e. ballast, p.f. correction capacitors and starters shall be housed inside the canopy.

3.10.5 The canopy shall have a cable entry suitable for GI pipe with outside diameter 50 mm. The fixture shall be suitable for cantilever mounting on G.I. pipe.

3.10.6 The fixture shall be suitable for 135 Watt low pressure sodium vapor lamp.

3.11 Mast top fixtures for vapor lamps

3.11.1 The reflector shall consist of an opal acrylic bowl secured to a cast aluminium spigot on a aluminium frame-work. The reflector shall be enclosed by an aluminium canopy.

3.11.2 The aluminium frame-work shall carry the lamp holders & control gear components like ballasts and starters.

3.11.3 The p.f. correction capacitor & the HRC fuses shall be housed in a separate box below the framework for easy replacement.

3.11.4 The aluminium frame-work shall be fixed to a G.I. pipe.

3.11.5 The G.I. pipe shall be suitable for mounting on a mast 14 m/18 m long.

3.11.6 The fixture shall be suitable for 250 Watt HPSV/400 Watt HPMV lamps.

3.12 Chokes

3.12.1 The chokes shall conform to relevant Standards

3.12.2 The chokes shall be electronic type.

3.13 Capacitors

3.13.1 The capacitors shall conform to relevant standards

3.13.2 The capacitors shall be hermetically sealed in aluminium starters

3.13.3 For twin tube lights these should be connected for anti-stroboscopic effects.
SPECIFICATION FOR 440 V POWER RECEPTACLES

1.0 SCOPE

1.1 This specification covers the requirements for 440 V power receptacles incorporating switches, sockets and plugs.

1.2 The receptacles shall comply with the latest version of IS 8623 except where modified or extended by this specification and with the relevant parts of standards mentioned in clause 2.0.

1.3 Any material, component or accessory not specifically stated in this specification but necessary for trouble free operation shall be deemed to be included.

2.0 OTHER RELEVANT STANDARDS

2.1 The other relevant standards applicable are as under:

- IS :6875 Switches and push-buttons
- IS :13703 LV fuses for voltages not exceeding 1000 V AC
- IS :2147 Degree of protection provided by enclosures for low voltage switchgear and control gear
- IS :3043 Code of practice for earthing
- IS :2629 Hot dip galvanising
- IS :5082 Wrought Aluminium and Aluminium alloys for electrical purposes
- IS :1248 Electrical Indicating instruments
- IS :5 Colours for ready-mixed paints and enamels.
- IS :1554 PVC insulated cables for working voltages upto and including 1100V
- IS :2551 Danger Notice Plates
- IE Rules 1956

2.2 Nothing in this specification shall be construed as to relieve the bidder of the responsibility for correctness of the design and construction of the equipment. Wherever the service conditions and requirements laid in this specification differ from the applicable standards, the conditions specified here in shall prevail.

Equipment complying with any other authoritative/internationally recognised standards such as IEC, BS, VDE etc. shall also be considered if it ensures performance equivalent or superior to Indian Standards. In such cases the bidder shall clearly indicate the standard adopted and furnish a copy of the latest version in English alongwith the bid and bring out the salient features for comparison.

The standard specifications and code of practices referred to herein shall be the latest edition including all applicable official amendments and revisions as published one month prior to the date of opening of bids. In case of conflict between this specification and those (IS Codes, Standards etc.) referred to herein, the former shall prevail.

3.0 SERVICE CONDITION

3.1 a) Ambient air temperature Maximum 50°C
b) Altitude Upto 1000 Meters above MSL
c) Location Heavily polluted with coal dust
3.2 **Operating Conditions**

- **a)** Nominal system voltage: 440 V (+10%)
- **b)** Supply frequency: 50 Hz (-5% to +3%)
- **c)** System earthing: Effectively earthed
- **d)** Highest fault level: 9 kA

4.0 **DESIGN**

4.1 **Electrical**

The receptacle shall be designed to ensure the following:

(i) Continuous operation at rated capacity at service condition already mentioned
(ii) Capacity to withstand fault level already mentioned.

4.2 **Mechanical**

The receptacle shall be designed to ensure the following:

(i) Ready interchangeability of components
(ii) Easy accessibility to components for inspection & maintenance

5.0 **CONSTRUCTION**

5.1 The receptacle shall comprise single front panel, metal enclosed, dust & vermin proof, floor mounted and free standing type. The frame shall be fabricated from suitable mild steel sheets of thickness not less than 2.0 mm. The frames shall be covered by cold-rolled steel sheets of thickness not less than 1.6 mm. Doors and covers shall also be of cold rolled sheets of thickness not less than 1.6 mm.

5.2 The panel edges and cover / door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members.

5.3 The complete structure shall be rigid, self-supporting, free from flaws, twists and bends. All cutouts shall be true in shape and devoid of sharp edges.

5.4 The panels shall be provided with a degree of protection IP 55.

5.5 The panel shall be supplied with base frames made of mild steel section along with all necessary mounting hardware required for welding down the base frame to the foundation / steel insert plates. The base frame height shall be such that floor finishing (50 mm thick) after erection of the board does not obstruct the movement of doors, covers withdrawable modules etc.

5.6 The panel doors shall open by at least 90 degree.

5.7 All components in a panel shall be neatly arranged and easily accessible for operation and maintenance.

5.8 The ON/OFF switches in a receptacle shall be rotary type, heavy duty, double break, AC 23 category, suitable for AC supply.

5.9 Plug and socket shall be of shrouded die cast Aluminium. Sockets shall be provided with lid safety cover.

5.10 Robust mechanical inter-lock shall be provided such that the switch can be put ON only when the plug is fully engaged. Plug can be withdrawn only when the switch is in OFF position. Additional inter-lock should be provided such that covers can be opened only when the switch is in off position.

5.11 Wiring inside the receptacles shall be carried out with 1100 V grade PVC insulated 6 Sq. mm stranded Aluminium conductor.
5.12 Terminal block in the receptacles shall be of 1100 V grade, clip on stud type, moulded in Melamine, suitable for terminating specified cable size. All the terminals shall be shrouded.

5.13 All wiring shall be properly supported, neatly arranged, readily accessible and securely connected to equipment terminals and terminal blocks.

5.14 All wiring terminations shall be made with solder less crimping type tinned copper lugs which shall firmly grip the conductor or an equally secured method. Insulating sleeves shall be provided over the exposed parts of lugs to the extent possible.

5.15 Receptacles shall include switches, sockets & plugs mentioned as under:
- 230V, 20A, SP, 2 Pin
- 415V, 20A, TP, 3 Pin
- 415V, 63A, TPN, 5 Pin

5.16 Galvanised steel earth bus shall be provided at the bottom welded / bolted to the bottom of a panel.

5.17 The earth bus shall have sufficient cross section to carry the short time fault current to earth, without exceeding the allowable temperature rise.

5.18 Suitable arrangement shall be made at each end of the earth bus for bolting to earthing conductors. The earth bus shall be projected out of the panel ends and shall have predrilled holes for this connection. All joint splices to earth bus shall be made through atleast two bolts and taps by proper lug and bolts connection.

5.19 All non-current carrying metal work in a panel shall be effectively bonded to the earth bus.

5.20 **Name plates and labels**
   a) The receptacle shall be provided with prominent, engraved identification plates.
   b) The name plates shall be of non rusting metal with white non graved letterings on black back grounds. Inscriptions shall be subject to purchaser's approval.
   c) Caution plate with the inscription "WARNING LIVE TERMINALS" shall be provided on the front face of a receptacle.

5.21 **Painting**
The sheet steel work shall be pre treated in accordance with relevant code. Degreasing shall be done by alkaline cleaning. Rust and scales shall be removed by pickling with acid. After pickling phosphate coating of class C in accordance with relevant code shall be provided. The phosphated surfaces shall be applied with stove lead oxide primer coating followed by two coats of finishing synthetic enamel paints. Electrostatic painting is also acceptable. Finishing paint on panels shall be shade 692 (smoke grey) in accordance with relevant code. The inner surface of the panels shall be glossy white. For electrostatic or powder painting manufacturer's standard shade for inner surface of the panels shall also be acceptable. Each coat of finishing paint shall be properly stoved. The finishing paint thickness shall not be less than 50 microns. Finished surfaces shall be coated by peelable compound by spraying method for protection against scratches, grease, dirt & oil spots. All hardware shall be nickel chromium plated or zinc passivated.
1.0 **SCOPE**

This specification covers requirement for procuring, commissioning and performance testing of lead acid battery for control, indication, alarm and protection circuit for 6.6 kV switchboard located in 6.6 kV switching station & Silo complex room.

Any material and component not specifically stated in this but necessary for trouble free operation of the equipment and accessories specified herein shall deemed to be included.

2.0 **STANDARDS TO BE FOLLOWED**:

2.1 The Battery shall be designed to comply with all applicable provision of current Indian standards.

Where Indian Standards are not available, International Standards which ensure performance equivalent or superior to Indian Standards shall be followed.

Nothing in this specification shall be construed as to relieve the supplier of the responsibility for correctness of the design and construction of the equipment.

All the standards being followed shall be listed out in the tender. Where any foreign standard is being followed, the copy of the same shall be provided with the tender.

Wherever service conditions and requirements laid down in this specification differ from applicable standards, the conditions specified herein shall prevail.

2.2 The battery shall comply with all the latest applicable statutory rules, regulations, acts and safety codes which may be in force during the period of execution and which are related with design, construction and operation of equipment in the locality where the equipment is to be installed.

The application acts and statutory regulations are as under :
   a) Fire Insurance Regulation
   b) Tariff Advisory committee Regulations
   c) The Indian Electricity Act.
   d) Indian Electricity rules
   e) National Fire Code
   f) DGMS Regulations

3.0 **BATTERY**

3.1 One bank of 220 volts battery unit each for switching station has and Silo been envisaged. One bank of 220 V Battery unit along with associated charging unit comprising of transformer, rectifier etc. shall be provided for control, indication, alarm and protection circuit for 6.6 kV switchingstatation & Silo.

3.2 The D.C. voltage shall be obtained from 440V, three phase, 4 wire, 50 Hz, AC supply after necessary rectification by the battery charger.
3.3 The battery charger shall have dual provision of:
   i) Boost charging the battery
   ii) Float charging the battery and supply the full DC load.

3.4 The battery shall be floating on the DC bus during the normal operation. The battery shall supply the DC power during emergency operation i.e. during failure of AC input power to the battery charger for at least one hour. The battery shall be of suitable rating to meet the requirement. The scope of design, supply and installation also includes a suitable DC Distribution Board along with necessary wiring, metering and protection arrangements.

3.5 The unit shall also conform to the following specifications:

1 Set: 220 Volts lead acid stationary battery, each consisting of tubular sealed cells (each of 2 volts) in hard rubber boxes complete with tubular positive plate, pasted negative plates, lids, vent plug, acid level indicating floats, separators, bolts and nuts, cell insulators, inter cell connectors etc.

Capacity: 160 AH when discharged in 10 hrs. to 1.85 volts per cell at 27°C.

Trickle charge rate: Minimum 75 mA to maximum 300 mA to keep the cell at 2.25 to 2.30 volts.

1 set: Connectors for the above battery.

1 Lot: Sufficient quantity of sulphuric acid for the first filling including spare acid 1.190 Sp. gr. at 27°C suitably packed.

1 set: Suitable battery stands made of good quality teak wood finished with three coats of black anti-sulphuric paint and complete with cell number plates and fixing nails.

3.6 The battery shall be maintenance free and complete with all accessories like hydrometer, cell testing voltmeter, thermometer (glass type) with gravity correction chart, spanner, glass funnel, Rubber siphon, Rubber Apron and gloves etc.

3.7 **Tests:**

The tenderer must ensure that the test mentioned in relevant BIS or Electricity Rules have been performed.
## ANNEXURE I

### TECHNICAL PARAMETERS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Service</td>
<td>Indoor</td>
</tr>
<tr>
<td>b) No. required</td>
<td>1 Set having 110 nos. x 2 Volts for 6.6kV Switchingstation. 1 Set having 110 nos. x 2 Volts for Silo.</td>
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<tr>
<td>c) Number of phases</td>
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<td>d) Frequency</td>
<td>50 Hz</td>
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<tr>
<td>e) Input supply</td>
<td>440V</td>
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<tr>
<td>f) Voltage variation in input supply</td>
<td>± 10%</td>
</tr>
<tr>
<td>g) Frequency variation</td>
<td>± 3%</td>
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<tr>
<td>h) Output nominal voltage</td>
<td>220V</td>
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<tr>
<td>i) Voltage regulation at output</td>
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<tr>
<td>j) Ripple without battery</td>
<td>± 4% RMS</td>
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<tr>
<td>k) Time required completing charging</td>
<td>8/10 Hours</td>
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<tr>
<td>l) Ambient temperature</td>
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<tr>
<td>m) Relative humidity</td>
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</tr>
<tr>
<td>n) Cooling</td>
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</table>
SPECIFICATION FOR CABLES

1.0 SPECIFICATION FOR XLPE INSULATED HT CABLES

1.1 SCOPE

1.1.1 This specification covers requirements for 6.6 kV grade XLPE insulated Aluminium conductor HT cables.

1.1.2 The cable shall comply with the latest version of IS:7098 except where modified or extended by this specification and with the relevant parts of standards mentioned in clause 2.0.

1.1.3 Any material, component or accessory not specifically stated in this specification but necessary for trouble free operation shall be deemed to be included.

1.2 CODES

The other relevant standards applicable are as under:
- IS : 10418 Specification of drums for electric cables
- IS : 8130 Conductors for insulated electric cables and flexible cords
- IS : 3975 Specification for mild steel wires, strips and tapes
- IS : 10462 Fictitious calculation method for determination of dimensions of protective covering of cables. Part I elastomeric and thermoplastic insulated cables
- IS : 2 Rules for rounding off values
- IS : 10810 Method of test for cables (Part 0 to Part 63)
- IS : 1885 Electrotechnical vocabulary part 32, cables, conductors and accessories
- IS : 4905 Methods for random sampling.

1.3 CONSTRUCTION

1.3.1 Material

(a) The conductor & insulation material shall be as under:
   The conductor shall be Aluminium wires
   The insulation used shall be Cross Linked Poly Ethylene compound.

(b) The fillers and inner sheath having FRLS property shall be either of the following types:
   - Unvulcanized rubber
   - Thermoplastic material
   - Proofed tapes (for inner sheath only)

The outer sheath shall be of Poly Vinyl Chloride (PVC) compound conforming to the requirements of Type ST 1 compound and having FRLS property. Unvulcanized rubber or thermoplastic material used for filler and inner sheath shall not be harder than PVC used for outer sheath. The material shall be chosen to be compatible with the temperature rating of the cable (90°C) and shall have no deleterious effect on any other component of the cable.
(c) Armouring shall be either of the following types: i) Galvanised round steel wire ii) Galvanised steel strip iii) Galvanised steel wires/ropes shall comply with the requirements of relevant Code. A binder tape on the armour shall be provided.

1.3.2 Constructional features

The conductor shall be of stranded construction complying with class 2 of relevant code. A protective barrier shall be provided between the conductor and the insulation and this shall be compatible with the insulating material and the operating temperature of 90°C.

The conductor with protective barrier shall be provided with XLPE insulation applied by extrusion. Cables rated 6.6/11 kV shall be provided with conductor screening and insulation screening.

The average thickness of insulation shall not be less than 3.6 mm, the tolerance of thickness of insulation shall not fall below 0.46 mm.

Core identification shall be made by numerals (1,2,3) either by applying numbered strips or by printing on the cores.

The cores with barriers shall be laid together with a suitable right hand lay. Where necessary, the interstices shall be filled with non-hygroscopic material.

The laid-up cores shall be provided with inner sheath applied either by extrusion or by wrapping.

It shall be ensured that the shape is as circular as possible

Inner sheath shall be so applied that it fits closely on the laid up cores and it shall be possible to remove it while terminating a cable without damaging the insulation.

The values of thickness of inner sheath shall not be less than 0.5 mm.

Armouring shall be provided over the inner sheath. The armour wires/strips shall be applied as closely as practicable.

The direction of lay of the armour shall be left hand. A binder tape may be provided on the armour.

The nominal thickness of steel strips shall not be less than 1.4 mm and the nominal diameter of round armour wire shall not be less than 4 mm.

The joints in armour wires or strips shall be made by brazing or welding and any surface irregularities shall be removed. A joint in any wire/strip shall be at least 300 mm from the nearest joint in any other wire or strip in the complete cable. The outer sheath shall be applied by extrusion over the armouring.

The colour of the outer sheath shall be black. The thickness of outer sheath shall be not less than 3 mm.
2.0 SPECIFICATION FOR 660/1100 V GRADE PVC ARMOURED CABLE
2.1 SCOPE
2.1.1 This specification covers requirements for 660 V/1.1 kV grade PVC insulated (Heavy duty) Armoured Aluminium conductor electric cables.

2.1.2 The cable shall comply with the latest version of IS:1554 (Part 1) except where modified or extended by this specification and with the relevant parts of standards mentioned in clause 2.0.

2.1.3 Any material, component or accessory not specifically stated in this specification but necessary for trouble free operation shall be deemed to be included.

2.2 CODES
The other relevant standards applicable are as under:

- IS : 10418 : Specification of drums for electric cables
- IS : 8130 : Conductors for insulated electric cables and flexible cords
- IS : 3975 : Specification for mild steel wires, strips and tapes
- IS : 5831 : PVC insulation for armouring cables and sheath of electric cables
- IS : 10462 : Fictitious calculation method for determination of dimensions of protective covering of cables. Part I elastomeric and thermoplastic insulated cables
- IS : 2 : Rules for rounding off values
- IS : 10810 : Method of test for cables (Part 0 to Part 63)
- IS : 1885 : Electro technical vocabulary part 32, cables, conductors and accessories
- IS : 4905 : Methods for random sampling.

2.3 CONSTRUCTION
2.3.1 Material
(a) The conductor and materials shall be as under:

The conductor shall be Aluminium wires conforming to relevant codes.

The insulation used shall be Poly Vinyl Chloride (PVC) compound conforming to the requirements of Type A and Type C compound conforming to relevant codes.

(b) The fillers and inner sheath having FRLS property shall be either of the following types:

Unvulcanized rubber or Thermoplastic material

Proofed tapes (for inner sheath only)

The outer sheath shall be of Poly Vinyl Chloride (PVC) compound conforming to the requirements of Type ST 1 compound conforming to relevant codes and shall have FRLS property.

Unvulcanized rubber or thermoplastic material used for filler and inner sheath shall not be harder than PVC used for insulation and for outer sheath. The material shall be chosen to be compatible with the temperature rating of the cable (70°C) and shall have no deleterious effect on any other component of the cable.
(c) Armouring shall be either of the following types: i) Galvanised round steel wire ii) Galvanised steel strip
   The Galvanised steel wires/ropes shall comply with the requirements of relevant Code. A binder tape on the armour shall be provided. 2.3.2

Construnctional features

The conductor shall be of stranded construction complying with class 2 of relevant codes. A protective barrier shall be provided between the conductor and the insulation and this shall be compatible with the insulating material and the operating temperature of 70 C.

The conductor with protective barrier shall be provided with PVC insulation applied by extrusion.

The average thickness of insulation shall not be less than 1 mm to 2.4 mm depending upon the nominal area of the conductor. The tolerance of thickness of insulation shall be such that the smallest of measured values of thickness of insulation shall not fall below 0.2 mm to 0.34 mm respectively.

Core identification shall be made by color scheme of PVC insulation by adopting the following:

<table>
<thead>
<tr>
<th>3 Core</th>
<th>31/2 Core or 4 Core</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red, Yellow, Blue</td>
<td>Red, Yellow, Blue, Black</td>
</tr>
</tbody>
</table>

The outer most layer of the cores shall be laid together with a suitable right hand lay and successive layers shall be laid with opposite lay. Where necessary, the interstices shall be filled with non-hygroscopic material.

The laid up cores shall be provided with inner sheath applied either by extrusion or by wrapping.

It shall be ensured that the shape is as circular as possible.

Inner sheath shall be so applied that it fits closely on the laid up cores and it shall be possible to remove it while terminating a cable without damaging the insulation.

The values of thickness of inner sheath shall not be less than 0.4 mm to 0.7 mm depending the nominal area of the conductor.

Armouring shall be provided over the inner sheath.

The armour wires/strip shall be applied as closely as practicable.

The direction of lay of the armour shall be left hand.

A binder tape may be provided on the armour. The armour of the cables shall consist of either galvanized round steel wires or galvanized steel strips.

The nominal thickness of steel strips shall be between 0.8 mm to 1.4 mm and the nominal diameter of round armour wire shall be between 1.6 mm to 4 mm.

The joints in armour wires or strips shall be made by brazing or welding and any surface irregularities shall be removed. A joint in any wire/strip shall be at least 300 mm from the nearest joint in any other wire or strip in the complete cable. The outer sheath shall be applied by extrusion over the armouring. The colour of the outer sheath shall be black. The thickness of outer sheath shall be between 1.4 mm to 3 mm depending upon the nominal area of the conductor.
3.0 SPECIFICATION FOR 660 /1100 V GRADE UNARMOURED CABLE

3.1 SCOPE

3.1.1 This specification covers requirements for 660 V/1.1 kV grade PVC insulated unarmoured Aluminium conductor electric cables for power supply to light & fan circuits.

3.1.2 The cable shall comply with the latest version of IS: 14449 except where modified or extended by this specification and with the relevant parts of standards mentioned in clause 2.0.

3.1.3 Any material, component or accessory not specifically stated in this specification but necessary for trouble free operation shall be deemed to be included.

3.2 CODE

The other relevant standards applicable are as under:
IS : 3961  Recommended current ratings for PVC insulated cables
IS : 5831  PVC insulation and sheath of electric cables
IS : 8130  Conductors for insulated electric cables and flexible cables
IS : 10810  Methods of tests for cables

3.3 CONSTRUCTION

3.3.1 Material

(a) The conductor and materials shall be as under:
   The conductor shall be Aluminium wires conforming to relevant codes.
   The insulation used shall be Poly Vinyl Chloride (PVC) compound conforming to the requirements of Type A compound conforming to relevant codes.

(b) The fillers and sheath having FRLS property shall be either of the following types:
    vulcanized rubber
    Unvulcanized rubber
    Thermoplastic material
    The filler material shall be suitable for continuous operation without exceeding 70°C & compatible with other components of the cable. Unvulcanized rubber or thermoplastic material used for filler shall not be harder than PVC used for insulation and sheath.

3.3.2 Conductor

(a) The construction of the conductors shall be for fixed wiring. Conductors shall be circular.

(b) The construction of the conductors shall be stranded only.

(c) The conductor shall be provided with PVC insulation applied by extrusion. The insulation shall be so applied that it fits closely on the conductor and it shall be possible to remove it without damage to the conductor. The thickness of the insulation shall be between 0.7 to 1 mm.
(d) The cores shall be identified by different colouring of PVC insulation, such as Red & Black.

(e) The cables shall have two cores laid side by side in the same plane with a suitable right hand lay.

(f) The sheath shall be applied by extrusion. It shall be applied over the laid up cores fitting closely and shall have FRLS property. It shall be possible to remove the sheath without damage to the sheath. The colour of the sheath shall be Black. The thickness of the sheath shall be between 0.9 to 1.4 mm.

4.0 SPECIFICATION FOR 660/1100 V GRADE CONTROL CABLE

4.1 SCOPE

4.1.1 This specification covers requirements for 660 V/1.1 kV grade PVC insulated Armoured copper conductor control cables.

4.1.2 The cable shall comply with the latest version of IS:1554 (Part 1) except where modified or extended by this specification and with the relevant parts of standards mentioned in clause 2.0.

4.1.3 Any material, component or accessory not specifically stated in this specification but necessary for trouble free operation shall be deemed to be included.

4.2 CODES

The other relevant standards applicable are as under:

- IS : 10418 : Specification of drums for electric cables
- IS : 8130 : Conductors for insulated electric cables and flexible cords
- IS : 3975 : Specification for mild steel wires, strips and tapes
- IS : 5831 : PVC insulation for armouring cables and sheath of electric cables
- IS : 10462 : Fictitious calculation method for determination of dimensions of protective covering of cables. Part I elastomeric and thermoplastic insulated cables
- IS : 2 : Rules for rounding off values
- IS : 10810 : Method of test for cables (Part 0 to Part 63)
- IS : 1885 : Electrotechnical vocabulary part 32, cables, conductors and accessories
- IS : 4905 : Methods for random sampling.

4.3 CONSTRUCTION

4.3.1 Material

(a) The conductor and materials shall be as under:

The conductor shall be Copper wires conforming to relevant codes.

The insulation used shall be Poly Vinyl Chloride (PVC) compound conforming to the requirements of Type A and Type C compound conforming to relevant codes.
(b) The fillers and inner sheath having FRLS property shall be either of the following types:

- Unvulcanized rubber or
- Thermoplastic material
- Proofed tapes (for inner sheath only)

The outer sheath shall be of Poly Vinyl Chloride (PVC) compound conforming to the requirements of Type ST 1 compound conforming to relevant codes and shall have FRLS property.

Unvulcanized rubber or thermoplastic material used for filler and inner sheath shall not be harder than PVC used for insulation and for outer sheath. The material shall be chosen to be compatible with the temperature rating of the cable (70°C) and shall have no deleterious effect on any other component of the cable.

(c) Armouring shall be either of the following types:

- a) Galvanised round steel wire
- b) Galvanised steel strip

The Galvanised steel wires/ropes shall comply with the requirements of relevant Code. A binder tape on the armour shall be provided.

4.3.2 Constructional features

The conductor shall be of stranded construction complying with class 2 of relevant codes. A protective barrier shall be provided between the conductor and the insulation and this shall be compatible with the insulating material and the operating temperature of 70°C.

The conductor with protective barrier shall be provided with PVC insulation applied by extrusion.

The average thickness of insulation shall not be less than 0.8 mm to 0.9 mm depending upon the nominal area of the conductor. The tolerance of thickness of insulation shall be such that the smallest of measured values of thickness of insulation shall not fall below 0.18 mm to 0.19 mm respectively.

Core identification shall be made by colour scheme of PVC insulation by adopting the following:

- 2 Core : Red, Black
- 3 Core : Red, Yellow, Blue
- 4 Core : Red, Yellow, Blue, Black
- 5 Core : Red, Yellow, Blue, Black, Grey
- 6 Core & above : Two adjacent cores (counting and direction core) in each layer, blue and yellow, remaining cores grey, or the core identification may be done by numbers. In that case, the insulation of cores shall be of the same colour and numbered sequentially, starting with number 1 for the inner layer. All the numbers shall be of the same colour which shall contrast with the colour of the insulation. The numerals shall be legible.
The outer most layer of the cores shall be laid together with a suitable right hand lay and successive layers shall be laid with opposite lay. Where necessary, the interstices shall be filled with non-hygroscopic material.

The laid up cores shall be provided with inner sheath applied either by extrusion or by wrapping.

It shall be ensured that the shape is as circular as possible

Inner sheath shall be so applied that it fits closely on the laid up cores and it shall be possible to remove it while terminating a cable without damaging the insulation.

The values of thickness of inner sheath shall not be less than 0.3 mm.

Armouring shall be provided over the inner sheath.

The armour wires/strips shall be applied as closely as practicable.

The direction of lay of the armour shall be left hand.

A binder tape may be provided on the armour. The armour of the cables shall consist of either galvanized round steel wires or galvanized steel strips.

The nominal thickness of steel strips shall be between 0.8 mm to 1.4 mm and the nominal diameter of round armour wire shall be between 1.4 mm to 4 mm.

The joints in armour wires or strips shall be made by brazing or welding and any surface irregularities shall be removed. A joint in any wire/strip shall be at least 300 mm from the nearest joint in any other wire or strip in the complete cable. The outer sheath shall be applied by extrusion over the armouring. The colour of the outer sheath shall be black. The minimum thickness of outer sheath shall be 1.24 mm.

5.0 FLEXIBLE TRAILING CABLES

Flexible Trailing cables shall be 6.6 kV/1.1 kV grades, 4 core flexible Trailing annealed tinned stranded copper conductor, EPR insulated, EPR inner sheathed, FRLS, GI wire braid armoured and CSP outer sheathed cables conforming to IS: 14494.

6.0 SPECIAL CABLES

Special cables shall be provided including but not limited to the following:

a) Temperature detectors from HT motors to the selector switches,

b) Level indicators from coal bunker level, Silo level

c) Temperature detectors to associated electronic enclosure, etc.

These cables shall be heavy duty Fire Retarding Low Smoke and self extinguishing, colour coded, shielded, armoured copper conductor 650/1100 volts grade coaxial screwed compensating mineral insulated etc.

7.0 PERFORMANCE

The cables shall carry the rated current for the type of installation and ambient temperature in accordance with the relevant Code. The cable shall also be able to withstand the fault level in accordance with the relevant Code.
8.0 TESTS & CERTIFICATES & IDENTIFICATION

The cable shall be tested in accordance with relevant codes. Results of Routine tests for High voltage test and Conductor resistance test and Bending test shall be supplied by the manufacturer before the consignment of the cable. The purchaser reserves the right to conduct Acceptance tests preceded by sampling in accordance with relevant codes. The results of the test certificate shall also indicate the identifications like manufacturer's name or trade mark, the voltage grade, year of manufacture. These identifications shall also appear printed or embossed on the outer sheath.

9.0 PACKING & MARKING

The cables shall be supplied on a drum of suitable size and packed in accordance with the provisions of relevant codes. The ends of the cable shall be sealed by means of non hygroscopic sealing compound.
## TECHNICAL INFORMATION FOR XLPE INSULATED HT CABLES

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
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<tr>
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<tr>
<td>Cable Code</td>
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<tr>
<td>Voltage Grade</td>
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<td>Conductor Size</td>
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<td>No. of Cores</td>
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<td>Shaething</td>
<td>FRLS</td>
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## TECHNICAL INFORMATION FOR 660/1100 V GRADE PVC ARMOURDED CABLE

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<td>Cable Code</td>
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<td>Voltage Grade</td>
<td>660/1100 V</td>
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<tr>
<td>Conductor Size</td>
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<tr>
<td>No. of Cores</td>
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<tr>
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## TECHNICAL INFORMATION 660/1100 V GRADE UNARMOURDED CABLE

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<tr>
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<td>Conductor Size</td>
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<td>No. of Cores</td>
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## TECHNICAL INFORMATION FOR 660/1100 V GRADE CONTROL CABLE

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<tr>
<td>Sheathing</td>
<td>FRLS</td>
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</table>
SPECIFICATION FOR ACCESSORIES OF CABLELING

1.0 **SCOPE**

1.1 This covers requirements for accessories of cabling work like cable trays, cable ladders, PVC & Steel conduits and fittings, support systems.

1.2 Any material, component or accessory not specifically stated in this specification but necessary for trouble free operation shall be deemed to be included.

1.3 Nothing in this specification shall be construed as to relieve the bidder of the responsibility for correctness of the design and construction of the equipment.

2.0 **CODE**

The applicable codes are as under:

- IS 732 Code of practice for electrical wiring
- IS 513 Cold rolled low carbon steel and strips.
- IS 1079 Hot rolled carbon steel and strips.
- IS 9537 Conduits for electrical installation.
- IS 2667 Fittings for rigid steel conduits for electrical wiring.
- IS 8309 Compression type tubular terminal ends for Aluminium conductors of insulated cables.
- IS 2629 Recommended practice for hot dip galvanizing.
- IS 2633 Methods for testing uniformity of coating of Zinc coated articles.
- IS 1367 Technical supply conditions for threaded steel fasteners.
- IS 1663 Method for tensile testing of steel sheet & strip of thickness 0.5 mm to 3 mm.

3.0 **CONSTRUCTION**

3.1 **Cable trays, fittings and accessories**

i) In RCC trenches, the cable trays shall be of cantilever construction, with one or multi tiers complete with matching fittings (like elbows, bends, reducers, tees, crosses, etc.), accessories (like side coupler plates etc.) and hardware (like bolts, nuts, springs, washers, etc.) as may be required. In vertical sections the trays shall be of ladder construction with one or multi tiers complete with matching fittings (like elbows, bends, reducers, tees, crosses etc.), accessories (like side coupler plates etc.) and hardware (like bolts, nuts, springs, washers, etc.) as may be required.

ii) Cable trays, fittings and accessories shall be fabricated out of rolled Mild Steel sheets free from flaws such as laminations, rolling marks, pitting etc. conforming to relevant codes. Minimum thickness of Mild Steel sheets used for fabrication of cable trays and fittings shall be 2mm. The thickness of side coupler plates shall be minimum 3 mm. These shall be hot dip galvanized.

iii) Cable trays in the RCC trenches shall be of standard width 250 mm and of standard lengths 2.5 metre. Cable ladders shall be of widths varying between 150 to 250 mm and of standard lengths 2.5 metre.

iv) Each size and type of cable tray / ladder of 2.5 metre length and 250 mm width simply supported at the ends and uniformly loaded @ 76 kg. per metre shall not have deflection at the mid span exceeding 7 mm.
3.2 **Support System for Trays and Cables**

The support system shall be fabricated from standard structural steel members. The cable trays and support system shall be painted after installation with one coat of red lead primer, one coat of oil primer followed by two finishing coats of Aluminium paint.

3.3 **Conduits, Fittings and Accessories**

Conduits offered shall be rigid steel & PVC complete with fittings and accessories (like bends, check nuts, sockets etc.). The size of the conduit shall be selected on the basis of maximum 40% fill factor and in accordance with relevant code.

i) **Rigid Steel Conduits**

Rigid steel conduits conforming to relevant codes shall be threaded on both sides and suitable for mechanical stresses. The threaded length shall be protected by zinc rich. Conduits shall be smooth at inside and outside. It shall be possible to pass wooden ball in a straight length of conduit. Diameter of ball shall be 2 mm less than the internal diameter of conduit. Conduits shall be plugged by PVC caps at the ends for storage and transportation. Outer surface of conduit shall be hot dip galvanized and shall have high protection against corrosive and polluting substances. Supplementary polymer or synthetic coating shall be preferred. However, galvanising or pollution withstand tests shall be done after removal of supplementary coating. Inner surface of a conduit shall be protected against corrosion and polluting substances by hot dip galvanising. Galvanising tests as per relevant codes to withstand four nos of dips each of one minute duration in CuSO4 solution shall be done. Fittings and accessories shall also be hot dip galvanised.

ii) **Junction / Joint Boxes & power receptacles circuits**

Junction Box/cable joint boxes with IP:55 degree of protection, shall comprise a case and a detachable cover or hinged doors constructed out of cold rolled steel sheet of minimum thickness 2 mm. Top of the boxes shall be arranged to slope towards rear of the box. Gland plate shall be 3 mm thick sheet steel with neoprene/synthetic rubber gaskets. All junction boxes shall be of adequate strength and rigidity, hot dip galvanised, and suitable for mounting on walls, columns & structures. The boxes shall include brackets, bolts, nuts, screws, glands, lugs, M8 earthing stud required for erection. Terminal blocks in side a junction box shall be of 660 volts grade in one piece moulding. It shall be complete with insulating barriers, clip-on-type terminal numbering for wiring diagrams & arranged to facilitate easy termination. Twenty percent spare terminals shall be provided in each terminal block.

iii) **Cabling Accessories:**

a) **Cable Glands**:

Cable glands shall be single compression type suitable for the voltage grade of cables and as per relevant codes. The glands shall be of robust construction capable of clamping cable and cable armour(for armoured cables) firmly without injury to insulation. The glands shall be heavy duty brass, machine finished and nickel chrome plated of minimum 10 micron thickness. All washers and hardware shall be made of brass with nickel chrome plating. Rubber components shall be of neoprene and of tested quality.
b) **Cable Lugs**

Cable lugs shall be tinned copper solder or crimping type suitable for the voltage grade of cables suitable for Aluminium conductor cables and copper conductor control cables.

c) **Galvanising**

Galvanising of steel components and accessories shall conform to relevant codes. The galvanising shall be uniform, clean, smooth, continuous and free from acid spots. Should the galvanizing of the samples be found defective, the entire batch of steel shall have to be re-galvanised at contractor's cost after pickling.

The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per relevant codes. The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads have the required zinc coating on them.

d) **Painting**

Cable supports and cable trays mounting structures and all other non galvanized parts shall be brushed before giving one coat of red lead primer, one coat of oil primer followed by two finishing coats of Aluminium paint.
SPECIFICATION FOR STEEL TUBULAR POLES FOR LIGHTING

1.0 SCOPE

1.1 This specification covers requirements for swaged type steel tubular poles for outdoor lighting.

1.2 The poles shall comply with the requirements of IS: 2713 except where modified or extended by this specification and with the relevant part or standards mentioned in clause 2.0.

1.3 Any material, component or accessory not specifically stated in this specification but necessary for trouble free operation shall be deemed to be included.

2.0 OTHER RELEVANT STANDARDS

The other relevant standards applicable are as under:

- IS:209 - Specification of Zinc
- IS:2633 - Method of testing weight, thickness, and uniformity of coating on hard dipped, galvanising articles.
- IS:728 - Method of determination of weight, thickness and uniformity of coating on galvanised articles other than wires & sheets.
- IS:1573 - Specification for zinc plating
- IS:5 - Colour for ready mixed paints and enamels.

3.0 CONSTRUCTION

3.1 The tubular poles shall consist of 3 or 4 sections of dimensions conforming to the relevant standard.

3.2 The thickness of the steel sheets shall conform to the relevant standards.

3.3 The section shall be hard dip galvanised in accordance with the relevant standards.

3.4 The section shall be applied with 2 coats of primer and one coat of final paint in accordance with the relevant standards.

3.5 In case of swan neck pole, top section shall be curved in accordance with the drawing enclosed. The lamp fixture shall freely fit in with the coupler. For other type of poles, the lamp fixture mounted on a bracket clamped on the pole at a height of not less than 7 m from the road surface and projecting at least 1.3 m into the road from the centre of the pole.

3.6 The lower most section shall be provided with a base plate having holes for firm fixation in the foundation. The height of the pole shall be 9 m. The bidder/supplier shall submit the dimensioned drawings for different sections for approval by Purchaser before fabrication.
1.0 SCOPE

This specification covers requirements for high masts for outdoor lighting with street light/flood light fixtures.

2.0 CONSTRUCTION

The mast shall comprise the following components:

2.1 The mast shall comprise sections of over 6 metre length. Each section shall be made of steel complying with I.S. 226 of appropriate grade, polygonal section, telescopic jointed and fillet welded with the exception of site joints. The welding shall be in accordance with B.S. 5135. Each section shall include one telescopic and welded joint which provides diaphragm stiffness to maintain the structural strength during delivery and in service. The whole mast shall be continuously tapered. A door shall be provided at the base of the mast to permit clear access to winch assembly and power supply sockets. The door shall be weather resistant with a heavy duty lock. The base flange of welded construction shall provide full strength to the mast assembly. The mast shall be delivered to site in sections and joined with sleeve joints. No welded or bolted joints shall be allowed.

2.2 The foundation shall be provided by anchor plates with high tensile bolts.

2.3 The entire mast section shall be hot dip galvanised in accordance with I.S. 2629. Each section shall be given two coats of primer and one coat of final paint in accordance with shade 631 of I.S. 5.

2.4 For installation and maintenance of the top luminaires assembly a winch shall be provided at the base of the mast. The winch shall be completely self sustaining without the need for brakes, springs, or clutches which require adjustment. The winch shall have one or more drums corresponding to number of steel ropes required for suspension of the top luminaires assembly. The drums shall be suitably grooved ensuring tidy rope lay and smooth return of the rope for each lay. At least 4 turns of rope shall remain on a drum when the top luminaire assembly is fully lowered.

The winch shall be manually operable and also by power tools incorporating two speed reversible 240 volt single phase 50 Hz AC/DC universal motor coupled by a gear assembly of adequate ratio. The driving spindle shall be positively locked when not in use by a suitable automatic means. The winch shall be self lubricated by an oil bath. The capacity, the operating speed and the recommended lubricant shall be clearly marked on each winch with an indelible label. Each winch shall be supplied in waterproof enclosure.
2.5 Separate pulleys shall be mounted on a chassis integral with a sleeve which slips over the top of the mast axially and in azimuth. The pulleys made of non-corrodible material and run on self lubricating bearings with stainless steel spindles shall take on steel wire ropes and electric cables on suitable grooves. Suitable guides and stops shall be provided for the steel wire ropes for correct guiding of the luminaire assembly. The pulley assembly along with chassis shall be hot dip galvanised in accordance with relevant code aforesaid. The assembly shall be supplied in a weatherproof enclosure.

2.6 Suitable steel wire ropes of the stainless type shall be provided.

2.7 Stainless steel stud of diameter not less than 12 mm shall be attached to the mast structure at a convenient point within the base compartment to provide a earthing point.

2.8 The luminaire assembly shall consist of radial steel conduits for cables supplying power to fixtures. The assembly shall have fixing arms and plates for mounting junction boxes. Junction boxes in two separable halves shall provide supply of power to different fixtures. The assembly shall be provided with buffer arrangements to prevent damage to the mast finish.

2.9 Multicore flexible power cables shall be terminated on metal cased plug and sockets in the base compartment of the mast. At the mast head cables shall be connected to the weather proof junction box aforesaid with nylon glands.

2.10 Extension leads of multicore cables shall be provided with plug and socket to enable the fixtures to be tested when in the lower most position using base compartment socket supply.
### TECHNICAL INFORMATION

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Height of mast</td>
<td>14 M/18M/25M/30M</td>
</tr>
<tr>
<td>2</td>
<td>Ground level diameter</td>
<td>300 mm/386 mm/440 mm/610 mm</td>
</tr>
<tr>
<td>3</td>
<td>Top section diameter</td>
<td>100mm/100mm/150mm/150 mm</td>
</tr>
<tr>
<td>4</td>
<td>Maximum projected area of luminairs</td>
<td>0.8 sq.metre/0.8 sq.metre/0.9 sq.metre/2.8 sq. metre</td>
</tr>
<tr>
<td>5</td>
<td>Maximum weight of the luminaire assembly</td>
<td>150 kg/150 kg/350 kg/350 kg</td>
</tr>
<tr>
<td>6</td>
<td>Number of sections</td>
<td>2/2/3/3</td>
</tr>
<tr>
<td>7</td>
<td>Length of longest section</td>
<td>not exceeding 11 metres</td>
</tr>
<tr>
<td>8</td>
<td>Luminaire assembly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>This shall comprise</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) High mast street light fixtures with aluminium body, integral control gear, lamp holder and variable optic reflector. The fixture shall be of IP 54 construction and suitable for mounting 400 watt HPSV lamp.</td>
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</tr>
<tr>
<td></td>
<td>b) Flood light fixture with aluminium body, integral control gear, lamp holder and cradle with fixture adjuster. The unit shall be of IP 54 construction and suitable for mounting 400 watt HPSV and 1000 watt Tungsten Halogen lamps.</td>
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SPECIFICATION FOR MISCELLANEOUS ITEMS

The following general requirements shall be applicable to all the miscellaneous items furnished under these specifications.

1. **Emergency Power Supply**

   For emergency power supply the following shall be provided:
   
   a) Air cooled type generator.
   c) Separate wiring should be provided from generator to strategic locations.
   d) Additional emergency lights shall be provided to other locations as per direction of site engineer, if felt necessary, within the maximum load of 5 kW.
   e) Inverter emergency lights shall be provided in all sub-stations and silo loading complex.
   f) For emergency light, minimum requirement of illumination level shall be 10 Lux. However, actual requirement shall be worked out by bidder.

2. **Conveyor Accessories**

   2.1 **Pull Cord Switches**
   
   Pull chord operated emergency stop switches shall be provided in one side along the entire length of conveyors at a spacing of 50 metres for emergency stopping of the conveyor. The switches shall be hand reset type, having a resetting lever. At least one Pull Cord Switch shall be provided for small conveyors. It shall be cast/metal clad and shall have weather proof enclosure. The pull chord shall be of adequate length and shall be of standard flexible galvanised wire. Pull chord switch shall also have operating signal facility.

   2.2 **Belt Sway switch**
   
   These switches shall be auto reset, double contact type, one for advance indication of excessive belt sway and the other for tripping the conveyor. The switch shall be complete with roller, levers, arm etc. and painted with anti corrosive paint. These switches shall be provided at a spacing of 50 metres. Minimum 4 nos. switches shall be provided for each conveyor i.e. 2 nos. at head end and 2 nos. at tail end of conveyor. It shall be provided with common bridging by-pass switch at the central desk which may be required to be used during starting and also during emergency.

   2.3 **Zero speed switch**
   
   These switches shall be electro-dynamic type. It shall be provided to trip the conveyor in case of belt speed falling below 80% of the rated speed. These switches shall also serve as belt sequence switches for the preceding conveyor. These switches shall have 1 NO & 1 NC change over contact. Zero speed switches shall be provided at the tail and/or preferably on drive end of each conveyor to keep the operational speed within a set limit. It shall have cast/metal clad dust and weather proof enclosure.
3.0 **Pressurisation and Air conditioning**

All the station buildings in CHP shall be pressurised from inside to prevent dust entry. All control rooms shall be air conditioned using required numbers of window type air conditioners each having capacity of 1.5 Te. MCC rooms, control rooms (including control room for substations) shall be pressurised with conditioning of inlet air (no. of air changes not less than 15) and humidity shall be controlled to ensure proper working of equipment and operating personnel inside the room. Requisite number of exhaust fans and ceiling fans shall be provided in rooms to ensure proper working conditions for equipment and personnel in the rooms in case of failure of pressurisation and air conditioning equipment.

4.0 **Metal Enclosed Non-segregated Phase Bus Duct**

4.1 Metal enclosed non-segregated phase bus duct assemblies shall be supplied for incoming connection from the transformers to MCCs.

    The enclosure shall be made of aluminium alloy. The section of the bus duct shall be rectangular. The design of the bus duct enclosure shall be of sturdy construction such that it will withstand the internal or external forces resulting from the various operating conditions. The enclosure sheet thickness shall not be less than 3 mm.

    The entire duct shall be designed for dust, vermin and weatherproof construction. A suitable aluminium sheet hood shall be provided to cover all outdoor bus duct enclosure joints to facilitate additional protection against rainwater ingress. Bus duct enclosure in the indoor portion shall have a degree of protection not less than IP-52 and that in the outdoor portion shall have a protection not less than IP-55 accordance with IS 2147.

    The inside of the bus enclosure shall be treated with black paint to enable efficient heat dissipation. The matt paint used shall be suitable for temperature experienced during continuous loading of the bus conductor.

    Flexible expansion joints for the enclosure shall be provided wherever deemed necessary by the Bidder. Necessary bonding shall be provided at the expansion points if made of insulating material.

    Enclosures shall be provided with flanged ends with drilling dimensions to suit the flanges at the switchgear and transformer terminals. The flanges shall be provided with gaskets, nuts, bolts, etc. Details of the flanges provided on transformer/switchgear ends shall be properly co-ordinated with bus duct Contactor.

    Suitable inspection covers shall be provided for periodic inspection of insulators. Handles shall be provided on each inspection cover to facilitate easy lifting.

    Synthetic/neoprene gasket shall be provided so as to satisfy the operating conditions imposed by temperature, weathering, durability etc. Flange gasket shall be provided at the equipment terminal connections.

    Bus duct enclosure shall be connected to station earth grid at both ends.
Necessary earthing arrangement as applicable shall be provided with clamps to receive station earthing bus. All accessories and hardware required for the earthing arrangement shall be provided by the bidder. Suitably rated GI earth strip shall run all along the bus duct and shall be bolted to each section of bus duct enclosure at least at two places.

4.2 **Busbar**

The material of the conductor shall be aluminium. The busbars shall be rated in accordance with the service conditions and the rated continuous and short time current ratings as specified.

Busbars shall be adequately supported on insulator to withstand dynamic stresses due to short circuit current specified, without permanent deformation. Successful bidder shall furnish calculations establishing adequacy of busbar for specified current rating during detailed design.

All busbar joints and bus tap joints shall be either silver faced or thoroughly cleaned at the joints, and a suitable no oxide contact grease applied before making a joint. Plain and spring washers shall be provided to ensure good contacts at the joints and lamps.

Flexible connections for terminations at transformer bushing and switchgear shall also be included in the bidder’s scope of supply.

Expansion joints made of aluminium strips shall be provided, wherever felt necessary by the bidder, to take care of expansion and contraction of the busbars under normal operating conditions.

All the joints shall be tested for temperature rise to establish the adequacy of design. The maximum temperature rise at the joints when carrying rated current shall not exceed 55°C with silver plated joints and 40°C with all other type of joints, over an outside ambient 50°C.

The busbar clamps at insulators shall be designed to withstand the forces due to momentary circuit current the busbars during expansion and contraction. The material of the clamps shall be aluminium alloy. Suitable aluminium spacers shall be provided, wherever necessary.

All bolts, nuts and lock washers used in the bus assembly shall be of high tensile steel, plated for corrosion resistance. Spring washers/Belleville washers shall be used.

Busbar support insulators shall be made of non hygroscopic non combustible, track resistant and high strength type porcelain or polyester fibre glass mounted material and shall be suitable to withstand the dynamic stress due to specified short circuit currents.

Facility shall be provided for supporting the indoor bus duct from ceiling, floors or beams. The outdoor bus ducts shall be supported from the floor by T-shaped steel structures.

All steel structures required for bus duct support shall be hot dip galvanised.

4.3 **Bus Duct space Heaters**

Space heaters shall be provided in the bus ducts, wherever the manufacturer considers necessary and recommends their provision for preventing harmful moisture condensation.

The space heaters shall be suitable for continuous operation on 240V AC, 50 Hz, single phase supply, and shall be automatically controlled by thermostats.
5.0 **FIRE FIGHTING SYSTEM**:
The switch-gear rooms in the sub-stations and all strategic points shall be provided with fire fighting equipment of the following class:

- **Class B (Foam type)**: IS : 933
- **Class A (Soda Acid)**: IS : 934
- **Class BC (Dry Powder)**: IS : 933

The equipment shall be portable, wall mounted with refilling and recharging facility from time to time.

6.0 **MISCELLANEOUS**:

6.1 **Painting**:
All electrical equipment should be painted with air drying synthetic enamel paint in accordance with respective manufacturer's standard practice.

6.2 **Standards**:
The electrical equipment included in this tender shall comply with relevant IS specifications and IS code of practice. In the absence of IS, BS any other standard of repute shall be followed.

6.3 **Tests**:
The offer shall include all test certificates as required by ISS and Indian Electricity Rules.

6.4 **Tools & Tackles**:
Tenderers shall quote separate price for standard tools and tackles required for maintenance of the electrical equipment. This shall also include the necessary measuring instruments, rubber mats & gloves etc.

6.5 **Fitting & Spares**:
All standard fittings should be provided. The tenderer shall quote item-wise unit price for spare parts.

6.6 **Two years fast moving spares**:
Tenderers shall also furnish the list of two years fast moving spares along with their prices separately.

6.7 **Technical Particulars**:
The supplier shall furnish the technical particulars duly filled as given elsewhere.

6.8 **Guarantee**:
All the supplies should be guaranteed for a period of one year from the date of installation and commissioning.

6.9 **Deviations**:
Deviations if any, from these specifications shall be clearly indicated in the offer.

6.10 **Completeness of Offer**:
The details given in the write-up/specifications (including drawings) in respect of electrical system/equipment are indicative, not exhaustive. The electrical system/equipment shall coordinate with mechanical system/equipment of the plant.
If any electrical component or equipment with associated wiring is considered necessary and desirable as per Indian Electricity Rules amended up to date read with various circulars issued by the Director General of Mines Safety, Dhanbad, or if the same is considered necessary and desirable to comply with the up-to-date engineering practices or with various Indian codes of Practices issued by the I.S.I. New Delhi from time to time the same shall be deemed to be a requirement of this tender specifications and same should consequently included in the offer not-with-standing the fact that such requirements are not clearly or specifically indicated in these specifications along with the associated drawings.

All the equipment attachments, required for the execution of works as per scope of work as envisaged in the document shall be designed, fabricated erected and maintained for efficient and satisfactory performance, and the bidder shall be solely responsible for the same and the same shall be deemed to be within the scope of the offer/work whether specifically mentioned or not in these documents and the bidder shall not be eligible for any extra claim on this issue.
1.1.1 SCOPE:

This shall include all work involved in grading, excavation, shoring, filling around foundations and disposal of spoil etc.

To arrange for boring and subsurface data regarding nature of soil, sub-soil water etc. shall be arranged by the contractor. The Contractor must satisfy himself of the character and volume of all works under this item and expected surface, subsurface and/or subsoil water to be encountered. He must also satisfy himself about general conditions of site and ascertain existing and future obstructions likely to come up during the execution of the Contract to carry out the work within this scope.

In general all relevant IS/CPWD/NBO codes/specifications shall be followed.

1.1.2 GRADING ETC:

The area to be excavated shall be cleared out of fences, trees, logs, stumps, bush, vegetation, rubbish, slush etc. and levelled up. Trees up to 30 cm girth shall be uprooted. Trees above 30 cm girth to be cut, shall be approved by the Engineer and then marked. Felling of trees shall include taking out roots up to 60 cm below ground level or 15 cm below formation level whichever is lower. After the tree is cut and roots taken out the pot holes formed shall be filled with good earth in 25 cm layers and consolidated unless directed by the Engineer otherwise. The trees shall be cut in suitable pieces as instructed by the Engineer.

Before earthwork is started, all the spoil and unserviceable materials and rubbish shall be burnt or removed from site to approved disposal areas as may be specified. Ashes shall be spread or removed. Useful materials, saleable timber, firewood etc. shall be property of the Owner and shall be stacked properly at the worksite in a manner as directed by the Engineer.
1.3 CLASSIFICATION:

All earthwork shall be classified under the following categories:

1.1.3.1 Ordinary Soil:

This shall include all kinds of soil, dry or wet, which can generally be excavated with spades, except soil containing 50 percent or more of kankar, moorum and/or shingle and soft or hard rock.

1.1.3.2 Hard Soil:

The soil, dry or wet, containing 50 per cent or more of kankar, moorum and/or shingle or other types of hard soil that usually requires use of pick axes shall be classified under this item. The decision of the Engineer in the matter of classification of this type of soil shall be final and binding on the Contractor. This class shall also include excavation in consolidated brick ballast and mud concrete.

1.1.3.3 Soft and Decomposed Rock:

This shall include rock, boulders, chalk, slate, laterite and all other materials which in the opinion of the Engineer is rock, but does not need blasting and could be removed with picks, crow bars and wedges. The mere fact that the Contractor resorts to blasting for reason of his own, shall not mean the rock to be classified as 'hard rock'. This shall also include excavation to macadam and tarred roads and paths.

1.1.3.4 Hard Rock:

This shall include rock or boulders which in the opinion of the Engineer, requires the use of blasting or chiselling for excavation. This shall include cutting of the existing structures coming in the way of excavation.

In case of any dispute regarding classification, the decision of the Engineer shall be final.

1.1.4 EXCAVATION FOR FOUNDATIONS AND TRENCHES:

All excavations shall be done to the minimum dimensions as required for safety and working facility. Prior approval of the Engineer shall be obtained by the Contractor, in each individual case, for the method he proposes to adopt for the excavation, including dimensions, side slopes, shoring, dewatering,
disposal etc. This approval, however, shall not in any way make the Engineer responsible for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner.

Prior to starting the excavation, the ground level at the location shall be checked jointly with the Engineer. The rough excavation may be carried upto a maximum depth of 150 mm above the final level. The balance shall be excavated with special care. If directed by the Engineer, soft and undesirable spots shall be filled up as instructed by the Engineer.

If the excavation is done to a depth greater than that shown on the drawing, or directed by the Engineer, due to Contractor's fault, the excess depth shall be filled up to the required level with cement concrete not leaner than 1:4:8 ordinary concrete or richer as directed by the Engineer in each individual case.

1.4.1.1 Protection :

The Engineer shall be notified by the Contractor as soon as the excavation is expected to be complete in 24 hours' time so that it may be inspected by him at the earliest. Immediately after approval of the Engineer, the excavation must be covered up in the shortest possible time. But in no case the excavation shall be covered up or worked on before approval by the Engineer.

Excavated materials shall be placed beyond 1.5 metres from the edge of the pit or trench or half the depth of the pit or trench, whichever is more or further away, if directed by the Engineer.

Excavation shall not be carried out below the foundation level of structures close by until required precaution have been done.

Adequate fencing shall have to be made enclosing the excavation.

1.1.4.2 Dewatering :

All excavations shall be kept free of water. Grading in the vicinity of excavations shall be controlled to prevent surface water running into excavated areas. The Contractor shall remove by pumping or other means, as approved by the Engineer, any water inclusive of rain water and subsoil water accumulated in excavation and keep the trench dewatered until the construction of foundation structure is complete. Sumps made for dewatering must be kept clear of the foundations. Method of pumping shall be approved by the Engineer but in any case, the pumping arrangement shall be such that there shall be no
movement of subsoil or blowing in due to differential head of water during pumping.

1.1.4.3 Timber Shoring:

1.1.4.3.1 General:

Timber shoring shall be 'close' or 'open' type, depending upon the nature of soil and the depth of pit or trench and the type of timbering shall be determined by the Engineer. It shall be the responsibility of the Contractor to take all necessary steps to prevent the sides of trenches and pits from collapsing.

1.1.4.3.2 Close Timbering:

Close timbering shall be done by completely covering the sides of the trenches and pits generally with short, upright members called 'polling boards'. These shall be of minimum 25 mm x 40 mm sections as directed by the Engineer. The boards shall generally be placed in position vertically in pairs, one board on each side of cutting and shall be secured by horizontal walling of strong wood at maximum 1.2 meter spacing, cross strutted with bollies or as directed by the Engineer. The length of the bollie struts shall depend on the width of the trench or pit.

In case where the soil is very soft and loose, the boards shall be placed horizontally against the sides of the excavation and supported by vertical walling, which shall be strutted to similar timber pieces on the opposite face of the trench or pit. The lowest boards supporting the sides shall be taken into the ground. No portion of the vertical side of the trench or pit shall remain exposed, so that the earth is not liable to slip out.

The withdrawal of the timber shall be done very carefully to prevent the collapse of the pit or trench. It shall be started at one end and proceeded systematically to the other end. Concrete or masonry shall not be damaged during the removal of the timber. No claim shall be entertained for any timber which cannot be withdrawn and is lost or buried.

1.1.4.3.3 Open Timbering:

In the case of open timbering, the entire surface of the side of trench pit is not required to be covered. The vertical boards of minimum 25 cm width and minimum 4 cm depth shall be spaced sufficiently apart to leave unsupported strips of maximum 50 cm average width. The detailed arrangement, sizes of the timber and the distance apart shall be subject to the approval of the Engi-
neer. In all other respects, specification for close timbering shall apply to open timbering.

1.1.4.4 Backfilling around foundations in pits, trenches, plinth or under floors:

1.1.4.4.1 Earth:

Earth used for filling shall be free from salts, organic or other foreign matter. All clods of earth shall be broken or removed. Material for backfilling shall generally be obtained from the spoil of excavation. But the Engineer shall have the option, in case of shortage of good selected earth obtained from excavation, to direct the Contractor to get the filling materials from approved borrow pits.

1.1.4.4.2 Filling in pits and trenches around structures:

As soon as the work in foundations has been accepted and measured, the spaces around the foundation structures in pits and trenches shall be cleared of all debris, brick bats, mortar droppings etc. and filled with earth in layers not exceeding 15 cm each layer being watered, rammed and properly consolidated before the succeeding one is laid. Each layer shall be consolidated to the satisfaction of the Engineer. Earth shall be rammed preferably with approved compaction machine. Usually, no manual compaction shall be allowed unless specifically permitted by the Engineer. The final surface shall be trimmed and levelled to proper profile as desired by the Engineer. In case of black cotton soil the backfilling shall be done with sand at the direction of the Engineer.

1.1.4.4.3 Plinth filling:

The plinth shall be similarly filled with earth as described hereinbefore in layers not exceeding 15 cm watered and consolidated with approved compaction machine or manually if specifically permitted by the Engineer. When the filling reaches the finished level, the surface shall be flooded with water for at least 24 hours, allowed to dry and then rammed and consolidated, in order to avoid any settlement at a later stage. The finished level of the filling shall be trimmed to the slope intended to be given to the floor. In case of black cotton soil replacement of top one metre soil with approved quality of sand shall be done.
1.1.4.4 Backfilling excavated earth in trenches for water pipes and drains:

General:

Earth used for filling shall be free from salt, organic or other foreign matter. All clods of earth shall be broken or removed. Where the excavated materials is mostly rock, the boulders shall be broken into pieces not bigger than 10 cm size in any direction, mixed with fine material consisting of decomposed rock, moorum or earth as available, so as to fill up the voids as far as possible and then the mixture shall be used for filling.

Filling in trenches

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed.

Where the trenches are excavated in soil, the filling shall be done with earth on the sides and top of pipes in layers not exceeding 15 cm., watered, rammed and consolidated, taking care that no damage is caused to the pipe underneath.

In case of excavation of trenches in rock the filling upto a depth of 30 cm or the diameter of the pipe whichever is more, above the crown of pipe or barrel shall be done with fine material such as earth, moorum, pulverised decomposed rock or ash according to the availability at site, in the same manner as mentioned in clause 2.1.4.4.2 hereinbefore. The remaining filling shall be done with rock filling of boulders as available to fill up the voids, watered rammed and consolidated.

1.1.4.5 Sand filling in trenches and other places:

At places backfilling shall be done with local sand if directed by the Engineer. The sand used shall be clean, medium grained and free from impurities. The filled-in-sand shall be kept immersed in water for sufficient time to ensure maximum consolidation. The surface of the consolidated sand shall be dressed to required level or slope. Construction of floors or other structures on sand fill shall not be started until the Engineer has inspected and approved the fill.

1.1.4.5 I.S. CODES:

All relevant IS codes/CPWD/NBO/International Standards shall be followed. A few of them are mentioned below:

- IS :1498 - Classification of soil for General Engineering purpose.
- IS :2293 - Safety code for working with construction machinery.
1.2 TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEELWORKS

1.2.1 SCOPE:
This specification covers general requirements for supply when specified, fabrication and delivery at site of structural and miscellaneous steel.

1.2.2 STEEL MATERIALS:
Steel materials shall comply with the I.S. specifications laid down under Clause 2.2.15.1 and/or called for on the approved design drawings.

1.2.2.1 SUPPLIED BY CONTRACTOR:
Contractor shall furnish owner/Engineer duplicate copies of all mill orders covering the material ordered by him for this project and also the test reports received from the Mills for Owner's/Engineer's information check and verification.

1.2.3 DRAWINGS:
1.2.3.1 Engineer reserves the right to make changes. Revisions to drawings are very likely to be made to reflect more updated requirements. Revisions to drawings and any new drawings made to include additional work by Contractor shall be considered a part of this specification and the Owner shall entertain no extra claim on this account.

1.2.3.2 Unless otherwise specified, the drawings and specifications are intended to include everything obviously requisite and necessary for the proper and entire completion of the work and the job shall be carried out accordingly for the completeness as required.

1.2.3.3 In the case of variations in drawings and specifications, the decision of the Engineer shall be final. Should Contractor in the execution of his work, finds discrepancies in the information furnished by Engineer, he shall refer such discrepancies to the Engineer before proceeding with such work.

1.2.4 FABRICATION:
1.2.4.1 General:
All workmanship and finish shall be of the best quality and shall conform to the best approved method of fabrication. All materials shall be finished straight and shall be machined true and square where so specified. All holes and edges shall be free of burrs. Shearing and chipping shall be neatly and accurately done and all portions of work exposed to view shall be neatly finished. Material at the shops shall be kept clean and protected from weather.
1.2.4.2 Connections:

1.2.4.2.1 Shop connections shall be either by welding, riveting or high strength bolts.

1.2.4.2.2 All major field connections shall be of high strength bolt, but standard M.S. Bolts (IS : 1363) may be used for field connections of light members such as purloins, girt, staircase stringers and landing beams, unless these bolts are permitted to be used by Engineer for other connections also.

1.2.4.2.3 High tensile bolts shall comply with the requirements of BS : 1083 heat treated to R quality or its equivalent in IS : 1367.

1.2.4.2.4 In all cases where bearing is critical, the unthreaded bolt shall bear on the members assembled. A washer of adequate thickness may be provided to exclude the threads from the bearing thickness, if a longer grip bolt has to be used for this purpose.

1.2.4.2.5 All members likely to collect rain water shall have drain holes provided.

1.2.4.2.6 Not more than one shop splice shall be provided to make up the full length of a member. Splicing near the mid span of any beam should be avoided. Splicing to be done after approval of the Engineer.

Straightening:

Rolled material, before being worked, shall be straightened, unless otherwise required/specified. If straightening or flattening is necessary, it shall be done by methods that will not injure the material. Long plates shall be straightened by passing through a mangle or levelling rolls and structural shapes by the use of mechanical or hydraulic bar straightening machines. Heating or forging shall not be resorted to without the prior approval of Engineer in writing.

Cutting:

Cutting may be shearing, cropping, sawing or machine flame cutting. All reentrant corners shall be shaped notch-free to a radius of at least 12 mm. Sheared or cropped edges shall be dressed to a neat workman like finish and shall be free from distortion and burrs. The machine flame cut edges shall be properly cleaned. Where machine flame cutting is permitted for high tensile steel, special care shall be taken to leave for high tensile steel, special care shall be taken to leave sufficient metal and all flame hardened material shall be removed by machining/edge planning.

1.2.4.4.1 Hand flame cutting shall be undertaken only if so permitted by Engineer and shall only be carried out by an expert in such work. Hand flame cut edges shall be ground smooth and straight.

1.2.4.4.2 Edge planning of sheared, cropped or gas cut edges is not intended unless the sheared, cropped or gas cut edges are such as to warrant it or specifically called for.
1.2.4.5 **Rolling and Forming:**

Plates for circular bins, bunkers, hoppers etc. shall be accurately laid off and rolled or formed to required profile/shape as called for on the drawings. Adjacent sections shall be match-marked for facilitating accurate assembly, welding and erection in the field.

1.2.4.6 **Punching and Drilling:**

1.2.4.6.1 Holes in secondary members such as purlins, girts, lacing bars etc. may be punched full size through material not over 12 mm thick. Holes must be cleaned out, without burr or ragged edges. Holes for all other connections shall be drilled accurately and the burrs removed effectively. Where several parts are to be drilled shall be first assembled, tightly clamped together and drilled through.

1.2.4.6.2 Sub-punching may be permitted before assembly, provided the holes are punched 3 mm smaller in diameter than the required size and reamed after assembly to the full diameter. The thickness of material punched shall not exceed 16 mm.

1.2.4.6.3 When batch drilling is carried out in one operation through two or more separable parts, these parts shall be separated after drilling and the burrs removed.

1.2.4.6.4 Holes for turned and fitted bolts shall be drilled to a slightly smaller diameter and reamed to a diameter equal to the nominal diameter of the shank or barrel subject to HB tolerance specified in IS : 919.

1.2.4.6.5 Where reamed members are taken apart for shipping or handling, the respective pieces reamed together shall be so marked that they may be reassembled in the same position in the final sitting up. No interchange of reamed parts will be permitted. Poor machining, over drilling and evality in holes shall be cause for rejection. Burning holes with gas is strictly prohibited.

1.2.4.7 **Riveting:**

1.2.4.7.1 All rivet steel used shall conform to either IS : 1148 or IS : 1149 as may be applicable.

1.2.4.7.2 The parts of riveted members shall be well pinned and firmly drawn together with bolts before riveting is commenced. The drifting done during assembling shall be only such as to bring the parts into position and shall not be such as to enlarge the holes or distort the metal. Contact surfaces inaccessible after riveting shall be painted before assembly prior to riveting. Rivets shall be heated uniformly to a light cherry red (1085°C) and driven while
1.2.4.7.3 Rivets when heated and ready for driving, shall be free from slag, scale and carbon deposit. When driven, they shall completely fill the holes. Rivet heads shall be full, neatly made, concentric with the rivet holes and in full contact with the surface of the member, gripping the members firmly. A driven rivet when struck sharply on the head with a quarter pound rivet testing hammer, shall be free from movement and vibration. Loose, burnt or otherwise defective rivets shall be replaced free of cost. In removing rivets, care shall be taken not to injure the adjacent metal and if necessary, they shall be drilled or cut with a rivet buster or chisel.

1.2.4.7.4 Wherever practicable, machine riveting shall be carried out by using machines of the steady pressure type. When necessary to drive rivets with a pneumatic riveting hammer, a pneumatic bunker shall be used for holding up, when practicable.

1.2.4.8 Bolting:

1.2.4.8.1 High Tensile Bolts:

   The material used for the manufacture of structural quality high tensile steel bolts, shall have a minimum tensile strength of 58 Kg/mm². Other mechanical properties shall conform to grade St-58-HT of IS : 961.
1.2.4.8.2 Bolts, nuts and washers and other fastening materials shall be stored in racks off the ground with coating of suitable protective oil.

1.2.4.8.3 All bolts, nuts and washers shall conform to the relevant Indian Standards.

1.2.4.8.4 Bolts shall be inserted in such a way that they may remain in position under gravity even before fixing the nut. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible materials. When assembled, all joint surfaces, including those adjacent to the washers, shall be free of scales except tight wall scales. They shall be free of dirt, loose scales, burns and other defects that would prevent solid sitting of the parts. Contact surfaces shall be free of oil, paint, lacquer or galvanising.

1.2.4.8.5 All high tensile bolts conforming to HT-58 of IS : 961 shall be tightened to provide, when all fasteners in the joint are tight, at least the minimum bolt tension as mentioned below:

<table>
<thead>
<tr>
<th>Nominal bolt dia (mm)</th>
<th>Minimum bolt tension (Kg.f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>8,300</td>
</tr>
<tr>
<td>22</td>
<td>10,200</td>
</tr>
<tr>
<td>25</td>
<td>11,900</td>
</tr>
</tbody>
</table>

Tightening shall be done by any one of the following methods:

1.2.4.8.5.1 Turn-of-nut method:

When the turn-of-nut method is used to provide the bolt tension as specified above, there shall first be enough bolts brought to a 'Snug tight' condition to ensure that the parts of the joint are brought into good contact with each other. 'Snug tight' is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary socket wrench. Following this initial operation, bolts shall be placed in any remaining holes in the connection and brought to snug tightness. All bolts in the joint shall then be tightened additionally by the applicable amount of nut reaction specified in Table below with tightening progressing systematically from the most rigid part of the joint to its free edges. During this operation there shall be no rotation of the part not turned by the wrench.
Bolt length not exceeding 8 diameters or 200mm

<table>
<thead>
<tr>
<th>Bolt length exceeding 8 diameters or 200mm</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 turn</td>
<td>2/3 turn Nut rotation is relative to bolt regardless of the element (nut or bolt) being turned. Tolerance on rotation $30^\circ$ over or under.</td>
</tr>
</tbody>
</table>

Bolts may be installed without hardened washers when tightening is done by the turn-of-nut method. However, normal washers shall be used.

Bolts tightened by the turn-of-nut method may have outer face of nut match marked with protruding bolt point before final tightening, thus affording the inspector visual means of noting the actual out rotation. Such marks can be made by the wrench operator by suitable means after the bolts have been brought up snug tight.

1.2.4.8.5.2 Calibrated Wrench Tightening:

When calibrated wrenches are used to provide the bolt tensions specified earlier their setting shall be such as to include a bolt tension 5% to 10% in excess of this value. These wrenches shall be calibrated at least once each working day by tightening in a device capable of indicating actual bolt tension, not less than three typical bolts of each diameter from the bolts being installed. Power wrenches shall be adjusted to stall or cut out at the selected tension. If manual torque wrenches are used, the torque indication corresponding to the calibrating tension shall be noted and used in the installation of all bolts of the tested lot. Nuts shall be in tightening motion when torque is measured. When using calibrated wrenches to install several bolts in a single joint, the wrench shall be turned to 'touch up' bolts previously tightened, which may have been loosened to the prescribed tension. Bolts tightened by means of a calibrated wrench shall be installed with a hardened washer under the nut or bolt head, whichever is the element turned in tightening.

In either of the above two methods, because of bolt entering and wrench operation clearance, tightening may be done by turning the bolt while the nut is prevented from rotating.

Impact wrenches, if used, shall be of adequate capacity and sufficiently supplied with air to perform the required tightening of each bolt in approximately ten seconds.
1.2.4.9 **Welding**:

1.2.4.9.1 Electrodes for shielded-arc manual welds shall comply with the requirements of IS : 814 and shall be of an approved make.

1.2.4.9.2 The electrodes shall be suitable for use in the position and type of work as laid down in the above specifications and as recommended by the manufacturer.

1.2.4.9.3 Electrode flux covering shall be sound and unbroken. Broken or damaged coating shall cause the electrodes to be discarded. Covered electrodes for manual-arc welding shall be properly stored in an oven prior to use in a manner recommended by the manufacturer and only an hour's quota shall be issued to each welder from the oven.

1.2.4.9.4 Electrodes larger than 5 mm diameter shall not be used for root-runs in butt-welds.

1.2.4.9.5 Welding plant and accessories shall have capacity adequate for the welding procedure laid down and shall satisfy appropriate standards and be of approved make and quality. All the electrical plant in connection with the welding operation shall be properly and adequately earthed and adequate means of measuring the current shall be provided.

1.2.4.9.6 All welds shall be made only by welders and welding operators who have been properly trained and previously qualified by tests to perform the type of work required as prescribed in the relevant applicable standards.

1.2.4.9.7 All welds shall be free from defects like blow holes, slag inclusions, lack of penetration, undercutting, cracks etc. All welds shall be cleaned of slag or flux and show uniform sections, smoothness of weld metal, feather edge without overlap and freedom from porosity.

1.2.4.9.8 Fusion faces and surfaces adjacent to the joint for a distance of at least 50 mm on either side shall be absolutely free from grease, paint, loose scales, moisture or any other substance which might interfere with welding or adversely affect the quality of the weld. Joint surface shall be smooth, uniform and free from fins, tears, laminations etc. Preparation of fusion faces shall be done in accordance with the approved fabrication drawings by shearing, chipping, machining or machine flame cutting except that shearing shall not be used for thickness over 8 mm.

1.2.4.9.9 In the fabrication of cover-plated beams and built up members all shop splices in each component part shall be made before such component part is welded to other parts of the member. Wherever weld reinforcement interferes with proper fit-up between components to be assembled for
1.2.4.9.10 welding, these welds shall be ground flush prior to assembly.

1.2.4.9.10 The members to be joined by filled fillet welding shall be brought and held as close together as possible and in no event shall be separated by more than 3 mm. If the separation is 1.5 mm or greater the fillet weld size shall be increased by the amount of separation. This shall only apply if the surfaces are completely sealed by welds. In all other cases the fit-up shall be close enough to exclude water after painting.

1.2.4.9.11 The separation between facing surfaces of lap joints and butt joints with backing plate shall not exceed 1.5 mm. Abutting parts, to be butt welded, shall be carefully aligned and the correct root gap maintained throughout the welding operation. Mis-alignments greater than 25 percent of the thickness of the thinner plate or 3 mm whichever is smaller shall be corrected and in making the correction the parts shall not be drawn into a slope sharper than 2 degrees (1 in 27.5).

1.2.4.9.11 Pre-qualified welding procedure recommended by appropriate welding standards and known to provide satisfactory welds shall be followed. For non-standard procedures, qualification tests as prescribed in IS : 823 shall be made to verify the adequacy of the procedures. A welding procedure shall be prepared by Contractor and submitted to Engineer for approval before start of welding. This shall include all details of welding procedure with reference to provisions of IS : 823 & IS : 4353. Approval of the welding procedure by Engineer shall not relieve Contractor of his responsibility for correct and sound welding without undue distortion in the finished structure.

1.2.4.9.12 Submerged arc, automatic or semi-automatic welding shall generally be employed. Only where it is not practicable to use submerged arc welding, manual arc welding may be resorted to.

1.2.4.9.13 Voltage and current (and polarity if direct current is used) shall be set according to the recommendations of the manufacturer of the electrode being used and suitability to thickness of material, joint, form etc.

1.2.4.9.14 The work shall be positioned for flat welding wherever practicable and overhead weld shall be avoided.

1.2.4.9.16 No welding shall be done when the surface of the members is wet nor during periods of high wind unless the welding operator and the work are properly protected.
1.2.4.9.17 In joints connected by fillet welds, the minimum sizes of single run fillet welds or first runs and minimum full sizes of fillet welds shall conform to the requirements of IS:816 and IS : 823.

1.2.4.9.18 Fillet welds larger than 8 mm shall be made with two or more passes.

1.2.4.9.19 All complete penetration butt welds made by manual arc welding, except when produced with the aid or backing material or welded in flat position, from both sides in square-edge material not over 8 mm thick with root opening not less than one-half the thickness of the thinner part joined, shall have the root of the initial layer gouged out on the back side before welding is started from that side and shall be so welded as to secure sound metal and complete fusion throughout the entire cross section.

1.2.4.9.20 Butt welds shall be terminated at the ends of joint in a manner that will ensure their soundness. There abutting parts are 20 mm or more in thickness run-on and run-off plates with similar edge preparation and having a width not less than the thickness of the thicker part joined shall be used. These extension pieces shall be removed upon completion of the weld and the ends of the weld made smooth and flush with the abutting parts. Where the abutting parts are thinner than 20 mm the extension pieces may be omitted but the ends of the butt welds shall then be chipped or gouged out to sound metal and side welded to fill up the ends to the required reinforcement.

1.2.4.9.21 Each layer of a multiple layer weld except root and surface runs may be moderately peened with light blows from a blunt tool. Care shall be exercised to prevent scaling or flaking of weld and base metal from overpeening.

1.2.4.9.22 No welding shall normally be done on parent material at a temperature below (-) 5°C. However, if welding is to be undertaken at low temperatures, adequate precautions as recommended in relevant Indian Standards shall be taken. When the parent material is less than 40 mm thick and the temperature is between (-) 5°C to 0°C, the surface around the joint to a distance of 100 mm or four times the thickness of the materials, whichever is greater, shall be preheated till it is hand warm. When the parent material is more than 40 mm thick, the temperature of the area mentioned above shall in no case be less than 20°C. All requirements regarding preheating of the parent material shall be in accordance with the relevant IS standard.

1.2.4.9.23 Electrodes other than low-hydrogen electrodes shall not be permitted for thickness of 75 mm and above.
Before commencing fabrication of a member or structure in which welding is likely to result in distortion and/or locked up stresses a complete programme of fabrication, assembly and welding shall be made and submitted to Engineer for approval. Such a programme shall include, besides other appropriate details, full particulars in regard to the following:

i) Proposed preheating in components such as flanges and pre-setting of joints to offset expected distortion.

ii) Make up of sub-assemblies proposed to be welded before incorporation on final assembly.

iii) Proposed joint forms, classification of wire and flux or covered electrodes, welding process including fitting and welding sequences with directions in which freedom of movement is to be allowed.

iv) Proposed number, spacing and type of strong-backs and details of jigs fixtures for maintaining proper fit-up and alignment during welding.

v) Any other special features like assembling similar members back to back or stress relief.

If so desired by Engineer, mock up welding shall be carried out at Contractor's cost to establish the efficiency of the proposed programme, with any modification suggested by the Engineer, in limiting distortion or/and residual stress to acceptable levels.

1.2.4.9.25 Inspection of Welds:

All welds shall be inspected for flaws by any of the methods described under clause 'Inspection'. The choice of the method adopted shall be determined by Owner/Engineer.

1.2.4.9.26 The Contractor shall carry out tests which establish soundness of welds. In case the tests uncover defective work, such tests will be at Contractor's cost and the Contractor shall correct such defects at his own cost and prove the soundness of rectified work at his own cost.

1.2.4.9.27 The correction of defective welds shall be carried out as directed by Engineer without damaging the parent metal. When a crack in the weld is removed, magnetic particles inspection or any other equally positive means
as prescribed by Engineer shall be used to ensure that the whole of the crack and material upto 25 mm beyond each end of the crack has been removed. Cost of all such tests and operations incidental to correction shall be to Contractor's account.

1.2.4.10 Tolerances:

The dimensional and weight tolerances for rolled shapes shall be in accordance with IS: 1852.

No rolled or fabricated member shall deviate from straightness by more than 1/1000 of the axial length or 10 mm whichever is smaller.

The length of members with both ends finished for contact shall have a tolerance of ± 1 mm.

Members without ends finished for contact bearing shall have a tolerance of ± 1.5 mm for members upto 10 metres long and a tolerance of ± 3 mm for members over 10 metres in length.

Lateral deviation between centre line of web plate and centre line of flange plate at contact surface in the case of built up sections shall not exceed 3 mm.

The combined warpage and tilt of flanges in welded built up sections shall not exceed 1/200th of the flange width or 3 mm whichever is smaller.

The deviation from flatness of welded plate girder web in the length between stiffeners or a length equal to the depth of the girder shall not exceed 1/150th of such length.

Deviations from the specified depth of welded girder measured at the centreline of the web shall not exceed ± 3 mm upto a depth of 1000 mm, ± 5 mm for depths above 1000 mm upto 2000 mm and +8 mm and -5 mm for depths over 2000 mm.

1.2.4.11 End Milling:

Column ends bearing on each other or resting on base plates and compression joints designed for bearing shall be milled true and square to ensure proper bearing and alignment. Base plates shall also have their surfaces milled true and square.
1.2.4.12 Erection of Altered and Rectified Steel:

This includes transportation of the rectified components to the site of erection, lifting to the required position, aligning in position, inclusive of all erection bolts, tack welding final welding. Alterations and rectification of fabricated steel or dismantled steel shall be deemed to be fabrication work involving change in length of the member or in cross section, such as welding additional flanges or web plates or cutting already welded plates etc. Additions to fabricated steel such as additional cleat angles, plugging drills holes, drilling additional holes and additional fabrication work of steel fabricated and stored at the fabrication shop shall not be deemed to be included as ‘alterations’ and shall be done by the Contractor without any extra cost to the Owner. However, if any re-fabrication/erection is due to the change suggested by the Owner/Engineer shall be paid at the mutual agreed rate.

1.2.5 INSPECTION:

1.2.5.1 General:

Contractor shall give due notice to Engineer/Owner in advance of the materials or workmanship getting ready for inspection. All rejected material shall be promptly removed from the shop and replaced with new material for Engineer/Owner’s approval or inspection. The fact that certain material has been accepted at Contractor’s shop shall not invalidate final rejection at site by Owner/Engineer if it fails to be in proper condition or has fabrication inaccuracies which prevents proper assembly. No material shall be painted or despatched to site without the inspection and approval by Owner/Engineer unless such inspection is waived in writing by Engineer.

Shop inspection by Engineer or his authorised representative or submission of test certificates and acceptance thereof by Engineer shall not relieve the Contractor from the responsibility of furnishing material conforming to the requirement of these specifications, nor shall it invalidate any claim which the Owner may make because of defective or unsatisfactory material and of workmanship.

Contractor shall provide all the testing and inspection services and facilities for shop work.

For fabrication work carried out in the field, the standard of supervision and quality control shall be maintained as in shop fabricated work. The inspection and testing shall be conducted in a manner satisfactory to the Engineer.
1.2.5.2 Material Testing:

The inspection and tests on structural steel members shall be as set forth below:

1.2.5.2.1 If mill test reports are not available for any steel materials the same shall be got tested by the Contractor to Engineer's satisfaction. The costs of such tests will be borne by the Contractor.

1.2.5.3 Test on welds:

1.2.5.3.1 Where root and intermediate passes of weld is examined by magnetic particle testing, such testing shall be carried out throughout its entire length in accordance with ASTM Specification E-109. In the case of completed welds, such tests shall be carried out in accordance with ASTM Specification E-109 or E-138 as decided by Engineer. If heat treatment is performed, the completed weld shall be examined after the heat treatment. All defects shall be repaired and re-tested. Magnetic particle test shall be carried out using alternating current. Direct current may be used with the permission of Engineer.

1.2.5.3.2 Liquid Penetrant Inspection:

In the case of welds examined by Liquid Penetrant Inspection, such tests shall be carried out in accordance with ASTM E-165 or IS : 3658. All defects shown shall be repaired and rechecked.

1.2.5.3.3 Radiographic Inspection:

All full strength butt welds shall be fully radiographed in accordance with the recommended practice for radiographic testing as per ASTM E-93 and Part U.W. 51 of ASME Code Section - VIII.

1.2.5.4 Dimensions, Workmanship and Cleanliness:

The structural steel members shall be inspected at all stages of fabrication and assembly to verify that dimensions, tolerances, alignment and surface finish, painting where specified are in accordance with the requirements shown on Contractor's approved shop drawings.

1.2.5.5 Inspection of Test Failure:

In the event of any failure of structural steel members to meet an inspection or test requirement, Contractor shall notify the Engineer or his authorised
representative. Contractor must obtain permission from the Engineer before repair is undertaken. The quality control procedures to be allowed to ensure satisfactory repair shall be subject to approval by Engineer. 1.2.5.6 Engineer has a right to specify additional inspection or testing as he deems necessary and the additional cost of such testing will be borne by Owner. Contractor shall maintain records of all inspection and testing which shall be made available to Engineer or his authorised representative.

1.2.6  **SHOP MATCHING** :

Some steelworks particularly columns along with the tie beams/bracings may have to be shop assembled to ensure satisfactory fabrication, obtaining of adequate bearing areas etc. if so desired by Engineer at no extra cost to Owner.

1.2.7  **DRILLING HOLES FOR OTHER WORKS** :

Holes in members required for installing equipment or steel furnished by other manufacturers or other Contractors shall be drilled in Contractor's shop as part of this Contract, the information for which will be supplied by Owner/Engineer before fabrication of the steel.

1.2.8  **STAIRWAYS AND INTERMEDIATE LANDINGS & GRATINGS** :

All stairways and intermediate landings shown on the drawings shall be fabricated as a complete unit and shall include grating treads, landings, hangers, brackets, struts, clips, bracing etc. as detailed or as necessary for connections to structural steel framing in places. Treads and landings shall be suitable for the prescribed loading and be furnished complete with one piece standard non-slip abrasive nosing of approved type. The maximum width of openings in gratings shall not exceed 40 mm. The minimum thickness of main bars shall be 5 mm. The usual span of gratings will not generally exceed 1.5 metres.

1.2.9  **HANDRAILS** :

Handrails shall be provided on open sides of platform stairways and around all opening as shown on drawing. Handrails shall be of standard weight galvanised steel pipe of flush welded construction, ground smooth using 32 mm nominal bore medium class pipe provided with double rail, top rail about 1 metre above platform level and pipe posts spaced not more than two metres apart. Angle handrail posts may be provided if specifically
called for in design drawings. Handrails around openings should have toe plates.

Smooth uniform curves and bends shall be provided at stair returns and also wheresoever required. Posts connected to curb plates shall have a net closure at the bottom and a 6 mm thick plate neatly welded to posts for attachments to curb plates. All necessary fittings including inner dowels at splices, brackets, belts, bends, flanges and chains, where required shall be plugged and welded. A minimum radius of three times the pipe diameter shall be provided at all points of direction changes in the handrail.

1.2.10 CHEQUERED PLATE:

Chequered plates used shall be 6 mm thick over plates or as indicated on drawings. The chequered plate pattern shall be approved by Owner/Engineer. Mild steel flats of suitable size shall be welded to the bottom portion of chequered plates at a designed spacing to stiffen chequered plates suitably. Chequered plates shall be fixed by tack welding of suitable size.

1.2.11 MARKING OF MEMBERS:

After checking and inspection, all members shall be marked for identification during erection. This work shall correspond to distinguishing marks on approved erection drawings and shall be legibly painted and stamped on. The erection mark shall be stamped with a metal dye with figures at least 20 mm high and to such optimum depth as to be clearly visible, even after a member is galvanised.

All erection marks shall be on outer surface of all sections and near one end, but clear of bolt holes. Marking shall be so stamped that they are easily discernible when sorting out members. The stamped marking shall be enriched boldly by a distinguishable paint to facilitate easy location.

Erection marks on like pieces shall be in identical locations. Members having lengths of three metres or more shall have the erection mark at both ends.
1.2.12 ERRORS:

Any error in shop work prevents proper assembling and fitting-up of parts in the field by moderate use of drift pins or moderate amount of reaming will be classified by Engineer as defective workmanship. All charges incurred by Owner/Engineer either directly or indirectly because of workmanship will be deducted from the amount due to Contractor before payment is made. The amount of such deduction will consist of the sum total of the costs of labour direct or indirect, material, plant, transportation, equipment, rental and overhead expenses.

In case Engineer chooses to reject the material because of poor workmanship the cost of all handling for returning the material to Contractor, if he so desires, shall entirely be to Contractors’ account and in all such cases, the cost of handling, transport and delivery to site shall be borne by Contractor.

1.2.13 PAINTING:

1.2.13.1 Painting after erection:

Field painting shall only be done after the structure is erected, levelled, plumbed and grouted in its final position and accepted by the Engineer. Painting shall not be done in frosty or foggy weather or when humidity is such as to cause condensation on the surface to be painted. The air temperature should not be less than $4.4^\circ$C and relative humidity greater than 80%.

Before painting, steel, which is delivered only with shop primer, shall be dried and thoroughly cleaned from all loose scale and rust. Paints shall be done by brushing or spraying. Steel work that has received a shop coat primer shall be cleaned with emery paper followed by application of a second coat of primer. Damaged areas shall be carefully cleaned and reprimed.

Painting shall proceed as soon as possible after cleaning and before further deterioration of the surface occurs. Two coats of approved paint shall be applied after approval of the Engineer and allowing a drying time according to the manufacturers instructions. In the case of red lead, after the second coat of primer, sufficient time shall be allowed for the red lead to dry thoroughly.

All field rivets, bolts, field welds and serious abrasions to the shop coat shall be spot painted with the same paint used for the shop coat. Where specified, surfaces which will be in contact after site assembly shall receive a coat of paint (in addition to any shop priming) and shall be brought together
while the paint is still wet.

Where the steel has received a metal coating in the shop, this coating shall be completed on the site so as to be continuous over any field welds, field rivets or bolts. Each coat of paint shall have an optimum thickness. The overall paint thickness should not be less than 100 microns.

1.2.13.2 Shop Paint :

1.2.13.2.1 After inspection and issue of test and acceptance certificate, all steel surfaces are to be painted or otherwise treated shall be dried and thoroughly cleaned by effective means of all loose millscale, rust and foreign matter as per IS : 1477 Part-I. The following methods like wire brushing, scraping and chipping, sand papering or cleaning, flame cleaning, sand blasting or shop blasting, chemical rust removal may be adopted for preparing the steel surface to be painted. Except where encased in concrete, all steel work shall be given one coat of approved metal protection as may be specified, applied thoroughly and evenly and well worked into the joints and other open spaces. Materials shall be of best quality available and procured directly from approved manufacturers. Samples shall be submitted to the Engineer for approval before procurement.

1.2.13.2.2 Surfaces not in contact, but inaccessible after shop assembly, shall receive two coats of shop paint, positively of different colours or such materials to prove use of two coats before assembly. This does not apply to the interior of sealed hollow sections.

1.2.13.2.3 Shop contact surfaces shall be cleaned by effective means before assembly, but not painted.

1.2.13.2.4 In the case of surface to be welded, the steel shall not be painted or metal-coated within minimum 50 mm distance of any edges to be welded, if the paint specified or the metal coating would be harmful to welders or impair the quality of the welds. Welds and adjacent parent metal shall not be painted prior to de-slagging, inspection and acceptance.

1.2.13.2.5 Machine finished surfaces shall be protected against corrosion by a suitable coating.

1.2.13.2.6 Primers should be applied by brushing, Red oxide shall be used as shop painting. Where two coats are specified to be applied at shop to inaccessible parts, the second coat shall be red oxide zinc chromate paint (primer)
conforming to IS : 2075.

1.2.13.2.7 In areas which are difficult to reach either by brushing or spraying, daubers, mops or both may be used by dipping the same in paints and pulling or pushing them through narrow spaces. Regarding the methods of application of paint, whether by spraying or brushing, the instructions of the manufacturers shall be followed.

1.2.14 GALVANISING:

1.2.14.1 General:

Structural steel work for switchyard or other structures as may be specified in the Contract shall be hot dip galvanised in accordance with the American Society for Testing and Materials Specification ASTM - A123 or equivalent Indian Standard Specifications. Where the steel structures are required to be galvanised, the field connection materials like bolts, nuts and washers shall also be galvanised.

2.2.14.2 Surface Preparation:

All members to be galvanised shall be cleaned, by the process of pickling, of rust, loose scale, dirt, oil grease, slag and spatter of welded areas and other foreign substances prior to galvanising. Pickling shall be carried out by immersing the steel in an acid bath containing either sulphuric or hydrochloric acid at a suitable concentration and temperature. The concentration of the acids and the temperature of the bath can be varied, provided that the pickling time is adjusted accordingly.

The pickling process shall be completed by thoroughly rinsing with water, which should preferably be warm, so as to remove the residual acid.

1.2.14.3 Procedure:

Galvanising shall be carried out by hot dip process in a proper and uniformly heated bath. It shall meet all the requirements when tested in accordance with IS : 2633 - Methods of testing weight, thickness and uniformity of coating on hot dipped galvanised articles. The zinc coating shall be uniform, clean and of a standard thickness on the entire surface of the materials galvanised.

After finishing the threads of bolts, galvanising shall be applied over the entire surface uniformly. The threads of bolts shall not be machined after galvanising and shall not be with zinc.

The threads of nuts may be tapped after galvanising but care shall be taken to use oil in the threads of nuts during erection.

The surface preparation for galvanising and the process of galvanising itself, shall not adversely affect the mechanical properties of the materials to
be galvanised. Where members are of such lengths as to prevent complete
dipping in one operation, great care shall be taken to prevent warping. Materials on
which galvanising has been damaged shall be acid stripped and re-galvanised
unless otherwise directed, but if any member becomes damaged after having been
dipped twice, shall be rejected. Special care shall be taken not to injure the skin on
galvanised surfaces during transport, handling and erection. Damages, if occur,
shall be made good in accordance with the provisions of this Specification or as
directed by the Engineer.

### 1.2.15 APPLICABLE CODES AND SPECIFICATIONS:

Unless otherwise specified therein, materials and workmanship shall conform to
the latest editions of the one or as many as applicable of the standards or their ap-
proved equivalents. All relevant IS codes/CPWD & NBO Specifica-
tions/International Standards shall be followed. A few of them are mentioned below:

#### 1.2.15.1 Materials:

<table>
<thead>
<tr>
<th>No.</th>
<th>IS Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>:226</td>
<td>Structural Steel (Standard Quality).</td>
</tr>
<tr>
<td>2</td>
<td>:808</td>
<td>Rolled steel beam, channel and angle Sections.</td>
</tr>
<tr>
<td>3</td>
<td>:961</td>
<td>Structural steel (Fusion welding quality).</td>
</tr>
<tr>
<td>4</td>
<td>:2062</td>
<td>Structural steel (Fusion welding quality).</td>
</tr>
<tr>
<td>5</td>
<td>:1977</td>
<td>Structural steel (Ordinary quality).</td>
</tr>
<tr>
<td>6</td>
<td>:1148</td>
<td>Rivet bars for structural purposes.</td>
</tr>
<tr>
<td>7</td>
<td>:1149</td>
<td>High tensile rivet bars for structural purposes.</td>
</tr>
<tr>
<td>8</td>
<td>:1363</td>
<td>Black hexagon bolts, nuts and lock nuts and black hexagon screws.</td>
</tr>
<tr>
<td>9</td>
<td>:1364</td>
<td>Precision and semi-precision hexagon bolts, screws, nuts and lock nuts.</td>
</tr>
<tr>
<td>10</td>
<td>:1367</td>
<td>Technical condition for threaded fasteners.</td>
</tr>
<tr>
<td>11</td>
<td>:1083</td>
<td>Precision hexagonal bolts, screws and nuts (BSE &amp; BSF threads). Plain washers.</td>
</tr>
<tr>
<td>12</td>
<td>:2016</td>
<td>Specification for covered electrodes for metal arc welding for mild steel.</td>
</tr>
<tr>
<td>13</td>
<td>:814</td>
<td>Acceptance tests for wire flux combinations for submerged arc welding.</td>
</tr>
<tr>
<td>14</td>
<td>:3613</td>
<td></td>
</tr>
</tbody>
</table>
1.3  TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEEL WORK :

1.3.1  SCOPE :

This specification covers general requirements for erection of structural and miscellaneous steel. In general all relevant IS codes/CPWD/NBO/International Standards shall be followed.

1.3.2  ERECTION SCHEME :

Each bid shall be accompanied by a broad erection scheme prepared by the bidder after a thorough study of the bid drawings and the site conditions. The erection scheme shall describe the methods proposed to be employed by the
Contractor for unloading, transporting within the site, handling, assembling, hoisting and erection of the structural and miscellaneous steel components and the type, capacity and quantity of equipment that the Contractor proposes to bring to site for all these operations. The scheme shall also indicate the strength and trade-wise compositions of the work force and supervisory personnel that will be deployed by the Contractor for the various operations.

1.3.3 SITE OPERATIONS:

1.3.3.1 An experienced and qualified superintendent shall be in full time charge of the job.

1.3.3.2 Contractor shall complete all preliminary works at site well before the arrival of structural steel, such as establishment of office, stores, unloading gantry, labour quarters if any, electrical and water connections, electrical winches, derricks, cranes, compressors, all tools and tackle, rivet guns, welding sets, torque wrenches, spud wrenches, staging etc. as part of his contract and any other work that may be necessary so as to start erection immediately after the arrival of first batch of steel at site.

1.3.3.3 Contractor shall furnish at his own expense, the necessary non-inflammable staging for hoisting materials or equipment required for the erection work and shall remove and take them away after completion of the job. Contractor shall also provide necessary passageways, fences, safety belts, helmets, lights and other fittings to the satisfaction of Owner/Engineer and to meet the rules of local authorities and for protection to his men and materials. A licensed electrician shall be kept on the job for full period to maintain Contractor's electrical equipment and connection.

1.3.3.4 Contractor shall protect all existing plant structures, piping, conduits, equipment and facilities against damage during erection. Any damage caused by Contractor shall be rectified entirely at Contractor's cost to the satisfaction of Owner/Engineer. If work has to be carried out adjacent to existing switchyards or electrical installations which are live, Contractor must ensure suitable safety precaution in consultation with Engineer.

1.3.4 HANDLING & STORAGE:

No dragging of steel shall be permitted. All steel shall be stored 300 mm above ground on suitable packing to avoid damage, in the order required for erection and with erection marks visible. All storage areas shall be prepared and maintained by Contractor. Steel shall not be stored in the vicinity of areas
where excavation or grading will be done and if stored temporarily, this shall be removed by Contractor well before such excavation and/or grading commences to a safe distance to avoid burial under debris.

1.3.5 ANCHOR BOLTS AND FOUNDATIONS:

1.3.5.1 Contractor shall carefully check the location and layout of anchor bolts before the foundations are constructed to ensure that the structures can be properly erected as shown in the drawings.

Anchor bolts may be provided with three nuts on upper threads portion, one of which may be used for levelling the column base to the required elevation and one will be a lock nut. All shim stock required for erection shall be of good m.s. plates and shall be supplied by Contractor at his cost.

1.3.5.2 A certain amount of cleaning of foundations and preparing the area is considered normal and shall be carried out by Contractor at no extra cost.

1.3.5.3 Where beams bear in pockets or on walls, bearing plates shall be set and levelled as part of the work. All grouting under column base plates or beam bearing plates will be carried out by the Contractor only after getting prior approval of the Engineer.

1.3.6 ASSEMBLY AND CONNECTIONS:

1.3.6.1 Field connections may be effected either by riveting, bolting, welding or by use of high strength bolts as shown on the design and erection drawings.

All welding shall be in accordance with IS : 816 - Code of practice for use of Metal arc welding for General Construction in mild steel and IS : 823 - Code of procedure for manual arc welding of mild steel.

All assembling shall be carried on a level platform.

1.3.6.2 Drifts shall be used only for drawing the work to proper position and must not be used to such an extent as to damage the holes. Size of drifts, larger than the nominal diameter of hole shall not be used. Any damaged holes or burrs must be rectified to the satisfaction of the Engineer.

1.3.6.3 Corrections of minor misfits and reasonable amount of reaming and cutting of excess stock from rivet shall be considered as a part of erection. Any error in shop which prevents proper fit on a moderate amount of reaming and slight hipping or cu/c cutting shall be immediately reported to Engineer.
1.3.7 **ERECTIO**N :

1.3.7.1 All structural steel shall be erected as shown on the drawings, proper size steel cable slings etc. shall be used for hoisting, guys shall not be anchored to existing structures, foundations etc. unless permitted by Engineer in writing.

1.3.7.2 Steel columns in the basement, if any, are to be lowered and erected carefully with the help of a crane and/or derrick without damaging the basement walls or floor.

1.3.7.3 Structural steel frames shall be erected plumb and true. All steel columns and beams shall be checked for plumb and level individually before and after connections are made. Temporary bracings shall be introduced wherever necessary to take care of all loads to which the structure may be subjected including erection equipment and the operation thereof. Such bracings shall be left in place as long as may be required for safety and stability.

1.3.7.4 As erection progresses, the work shall be securely bolted to take care of all dead load, wind, seismic and erection stresses.

1.3.7.5 No riveting or welding or final bolting shall be done until the structure has been properly aligned and approved by Engineer. No cutting, heating or enlarging of the holes shall be carried out without the prior approval of Engineer.

1.3.8 **INSP**ECTION :

Engineer/Owner or their authorised representatives shall have free access to all parts of the job during erection and all erection shall be subject to their approval. In case of faulty erection all such dismantling and re-erection required will be at Contractor's cost. No paint shall be applied to rivet heads or field welds or bolts until these have been approved by Engineer.

1.3.9 **TO**LERANCE :

The shift of column axis at column base from the marked axis shall not exceed 5 mm. All column tiers shall be plumb within a tolerance of 1 in 500 and the structure as a whole plumb within a tolerance of 1 in 1000. In no case, however, shall the displacement from plumb of column tiers exceed 10 mm and the total displacement of the structure as a whole exceed 25 mm, for struc-
tures taller than 50 metres an additional displacement of 1 mm & for every 2.5 metres additional height to a maximum displacement of 50 mm. The actual levels of supports of trusses, collar beams, roofing beams, purling, etc. shall not vary by more than 20 mm from their marked levels. The sweep of trusses, beams etc. in the horizontal plane shall not exceed 1/1500 of their span subject to a maximum of 10 mm. Further, the deviation of the upper chords of trusses from vertical plane through centres of supports shall be within 1/250th of the truss height. Deviation in spacing of purling shall be within 5 mm.

1.4 TECHNICAL SPECIFICATION FOR EXCAVATION OF HARD ROCK:

1.4.1 SCOPE:

The work covers all operations connected with excavation of Hard Rock including all labour and material. The definition of Hard Rock should be as specified in specification for Preparation of Site and Earthwork in foundation and trenches.

1.4.1.1 GENERAL:

Excavation in hard rock shall generally be done by blasting. A valid blasting licence shall be obtained by the Tenderer from authorities concerned. If the permission for blasting is refused by the Engineer for safety considerations the rock shall be removed by wedging, picking, barring, burning and sudden quenching or other approved means. All the excavation beyond the minimum excavation limits shall be filled back with the same class and type of material as proposed and approved by the Engineer. While blasting the Tenderer shall take all possible care to preserve rock below and beyond the lines of excavation in the soundest condition possible.

1.4.1.1.1 BLASTING:

For blasting operations required in case of excavation of rock, the following points shall be observed:

The Tenderer shall employ a competent and experienced supervisor and li-
licensed blaster incharge of each set of operation who shall be held personally responsible to ensure that all safety regulations are followed. Before any blasting is carried out, the Tenderer shall intimate the Engineer and obtain his approval in writing for resorting to such operations. He shall intimate the hours of firing charges, the nature of explosive and extent to be used and the precautions to be taken for general safety.

The Tenderer shall ensure that all workmen and the personnel at site are excluded from the unsafe area, to be determined by the Engineer, at least 15 minutes before firing by sounding warning siren. The area shall be encircled by red flag. Within 30 metres from structures no blasting shall be done without prior approval of the Engineer in writing. When blasting is necessary adjacent to partially or completely built structures in the area, the Tenderer shall take all the precautions necessary to prevent flying rock from causing damage to the structures.

The Tenderer shall be responsible for all damage caused by blasting and shall replace or repair the structures at his own cost. All major blasting shall be completed prior to starting concrete work on site.

1.4.1.1.2 LINE BLASTING:

Line drilling for rock blasting if required shall be done as per following methods. One line of holes is proposed to be drilled as 'line drilling' where rock has to be blasted, in case of uniform excavation over the entire area. The maximum spacing of holes shall be 150 mm and dia of holes 48 mm. This line drilling will be very close to the area excavated as directed by the Engineer, from the face of the excavation area. In addition to above the Engineer may order further line drilling at suitable location to facilitate safe excavation.

In case of uniform excavation over the entire area, the layout of the interior blasting holes shall be carefully planned in such a way that no interior hole is closer than 2.5 M to the line drilled holes. Only light blasting is permitted in the interior holes which are near the line drilled holes. The Tenderer may carryout tests to determine the amount of explosive required to ensure an even break at the line drilled holes and that no damage occurs to the structures wall and rock beyond excavation limits. After the interior holes are blasted any irregularities in the vertical face which was line drilled shall be removed and trimmed by wedging, splitting, chiselling and barring. Excavation shall proceed from the
centre to the outside.

1.4.2 EXCAVATION BY BLASTING:

The Tenderer shall employ a competent and experienced supervisor and licensed blaster in charge of each set of operation, who shall be held personally responsible to ensure that all safety regulations are carried out. Before any blasting is carried out, the Tenderer shall intimate the Engineer and obtain his approval in writing for reporting to such operation. He shall intimate the hours of firing charges, the nature of explosive to be used and the precautions to be taken for general safety.

The Tenderer shall ensure that all workmen and the personnel at site are excluded from the area of 20M radius from the firing point, at least 15 minutes before firing time by sounding warning siren. The area shall be encircled by red flag.

The blasting or rock near the existing buildings, equipments or any other property shall be done under cover and the Tenderer has to make all such necessary muffling arrangements. Covering may preferably be done by M.S. Plates with adequate dead weight over it. The blasting shall be done with small charges only and where directed by the Engineer, a trench shall have to be cut by chiselling prior to the blasting operation separating the area under blasting from the existing structures. The firing shall be supervised by a Supervisor and not more than 6 holes at a time shall be set off successively. If the blasts do not tally with the numbers fired, the difference indicating the misfired shall be carefully located after half an hour and when located shall be exploded by drilling a fresh hole along the misfired hole (but not nearer than 600 mm from it) and by exploding a new charge.

A wooden tamping rod shall be used to push cartridges home and metal rod or rammer shall not be permitted on the site of work. The charge shall be placed firmly into place and not rammed or pounded. After a hole is filled to the required depth, the balance of the hole shall be filled with stemming which may consist of sand or stone dust or similar inert material.

The Tenderer shall preferably fire the explosive electrically. The explosive shall be exploded by means of a primer which shall be fired by a detonator by a fuse instantaneous detonator (F.I.D.) or other approved cables. The detonators with F.I.D. shall be connected by special nippers.

In dry weather and normal dry excavations, ordinary low explosive gunpowder may be used. In damp rock, high explosive like gelatine with detonator and
fuse wire may be used. In underwater or excavation with substantial seepage causing accumulation, electric detonation shall be necessary. Holes for charging explosive shall be drilled with pneumatic drills, the drilling pattern being so planned that rock pieces after blasting will be suitable for handling without secondary blasting.

When excavation almost reaches the level, hand trimming shall have to be done for dressing the surface to the desired level. Any extra excavation shall be filled up as instructed by the Engineer, preferably by cement concrete with a mix not leaner than 1:3:6.

The Tenderer shall be responsible for any accident to workmen, public or damage to Owners' property due to blasting operations. The tenderer shall also be responsible for strict observance of rules, laid down by the Inspector of Explosives, or any other authority, duly constituted under the State Government or the Union Government. The tenderer shall be liable to pay the compensation arising due to accident/damage occurred due to blasting operation.

1.4.2.1 PROCUREMENT & STORAGE OF EXPLOSIVES :

The Owner shall obtain for the Tenderer necessary licence from the authorities dealing with explosives, but fees, if any, required for obtaining such licence shall be borne by the Tenderer. The Tenderer shall have to make necessary storage facilities for the explosives as per rules of local Authorities/Govt. of India. Explosive shall be kept dry and shall not be exposed to direct rays of sun or in the vicinity of fire, stoves, steam pipes or heated metal etc. No explosive shall be brought near the work in excess of quantity required for a particular amount of firing to be done; any surplus left after filling the holes shall be removed at least 400 metres from the firing point.

1.4.3 LIMITATIONS :

For blasting, the following restriction will be in force. Blasting limits and charges will be as follows:

1. Within 24 hours after concreting up to 100 metres, no blasting is permitted.
2. During concreting (any time) beyond 100 metres blasting only within 2 Kg/delay. 3. 24 hours after concreting beyond 100 metres up to 14 Kg/delay.
Within 30 metres from structures, no blasting shall be done without prior approval of the Engineer in writing.
When blasting is necessary, adjacent to partially or completely built structures, the Tenderer shall take all precautions necessary to prevent flying rock from causing damage to the structures.
The tenderer shall be responsible for all damages caused by blasting and shall replace or repair the structures at his own cost to the satisfaction of the Engineer. All major blasting shall be completed prior to starting concrete work at site.

1.4.4 I.S. CODES:
All relevant IS codes/CPWD/NBO/International Standards shall be followed. A few of them are mentioned below:
IS : 6922 - Criteria for Safety and design of structures subjected to underground blasts.

1.5 TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED) : 1.5.1

SCOPE:
1.5.1.1 This specification deals with Cement Concrete, Plain or Reinforced, for general use, and covers the requirements for concrete materials, their storage, grading, mix design, strength and quality requirements, pouring at all levels, reinforcements, protection, curing, formwork, finishing, painting, admixtures, inserts and other miscellaneous works.

1.5.1.2 The provision of the latest revision of IS : 456 shall be complied with unless permitted otherwise and any other Indian Standard Code (latest revision) shall form a part of this Specification to the extent it has been referred to or applicable within this specification.

1.5.2 MATERIALS:

1.5.2.1 Cement:
Cement shall be ordinary portland cement conforming to IS : 269 latest revision or portland slag cement conforming to IS : 455 latest revision OR
PORTLAND POZZOLONA CEMENT
CONFIRMING TO is1498 pART-1. Rapid hardening portland cement may be used under special circumstances if permitted by the Engineer.

1.5.2.2 Aggregates:

All aggregates shall conform to all provisions and test methods of IS : 383 latest revision and/or IS : 515 latest revision.

Samples of aggregates, proposed to be used shall be submitted free of charge in sufficient quantities to the Engineer with sieve analysis data for his approval. Approved samples will be preserved by him for future reference. This approval will not in any way relieve the Contractor of his responsibility of producing concrete of specified qualities.

1.5.2.2.1 Coarse Aggregates:

Coarse aggregates shall consist of uncoated, hard, strong, dense and durable pieces of crushed stone and shall be free from undesirable matters viz. disintegrated stones, soft, flaky or elongated particles, salt, alkali, vegetable matter or other deleterious substances. The amount of different undesirable substances in coarse aggregates shall not exceed the percentage limits by weight as specified in relevant IS Codes, but in no case, the total amount of all the undesirable substances shall exceed 5%. Aggregates other than crushed stone conforming to the provisions of this Specification may be used under special conditions, if permitted by the Engineer.

Washing of aggregates by approved means shall be carried out, if desired by the Engineer. The Maximum size of coarse aggregates shall be as follows:

For:
- Reinforced concrete including foundations - 20 mm
- Ordinary Plain concrete - 20 mm
- Heavy - 40 mm

Grading of coarse, aggregate for a particular size shall generally conform to relevant IS Codes and shall also be such as to produce a dense concrete of the specified proportions and/or strength and consistency that will work readily into position without segregation.

1.5.2.2.2 Fine Aggregates - Sand:

Sand shall consist of siliceous material having hard, strong, durable, uncoated particles, free from undesirable amounts of dust, lumps, soft or flaky particles or other deleterious substances. The amount of different undesirable substances shall not exceed the percentage limits by weight as specified in relevant IS Codes; but in no case, the total amount of all undesirable substances shall exceed 5% by weight.
Manufactured sand, other than natural sand, conforming to the provision of this Specification may be used under special conditions, if permitted by the Engineer.

Washing of aggregates by approved means shall be carried out, if desired by the Engineer at no extra cost to the Owner.

Coarse and fine sand shall be well graded within the limits by weights as specified in relevant IS Codes. Fineness modulus shall not vary by more than plus or minus 20 percent from that of the approved sample.

1.5.2.3 Water:

Water shall be clean, fresh and free from organic or other deleterious matters in solution or in suspension in such amounts that may impair the strength or durability of the concrete. Potable water is generally satisfactory.

1.5.2.4 Admixtures:

The use of admixture in concrete for promoting workability, improving strength, entraining air or for any other purpose may be used only with the approval of the Engineer.

1.5.2.5 Reinforcement:

Reinforcement steel shall be clean and free from loose mill scales, dust, loose rust and coats of paints, oil, grease or other coatings, which may impair or reduce bond. It shall conform to the following I.S. Specifications:

i) Mild steel and medium tensile steel bars and hard drawn steel wire conforming to IS : 432 ; ii) Deformed bars conforming to IS : 1139 ;

ii) Cold twisted steel bars conforming to IS : 1786 and

iv) Structural steel sections conforming to IS : 226 or IS : 2062.

All steel reinforcements including and above 6 mm diameter shall necessarily be of tested quality.

1.5.2.6 Form work:

Form work shall be composed of steel and/or best quality shuttering wood of non-absorbent type. Timber shall be free from knots and shall be of medium grain as far as possible. Hard wood shall be used as caps and wedges under or over posts. Ply-wood or equivalent shall be used where specified to obtain smooth surfaces for exposed concrete work. Struts shall generally be mild steel tubes, and strong sal ballahs 150 mm in diameter of above. Bamboos, small diameter ballahs etc. shall not be used unless approved by the Engineer in specific cases.
1.5.3 STORAGE OF MATERIALS:

All materials shall be so stored as to prevent deterioration or intrusion of foreign matter and to ensure the preservation of their quality and fitness for the work. Any material, which has deteriorated or has been damaged or is otherwise considered defective by the Engineer, shall not be used for concrete and shall be removed from site immediately, failing which, the Engineer shall be at liberty to get the materials removed and the cost thereof shall be realised from the Contractor's dues.

1.5.4 GRADES OF CONCRETE:

General:

Concrete shall be either ordinary or controlled and in grades designated as M-15, M-20 etc., as specified in IS : 456. Lean concrete shall be 1:4:8 mix with aggregate of nominal size 40 mm maximum or as indicated in drawings or other contract documents.

1.5.4.1 Ordinary Concrete:

Ordinary concrete is recommended only when accurate control is impracticable and not necessary. However, if ordinary concrete is allowed by the Engineer, it shall be used only in the concrete of grades M-15 and M-20. Ordinary concrete does not require preparation of trial mixes.

1.5.4.1.1 Concrete mix proportions for ordinary concrete shall be as per IS : 456 and as follows:

<table>
<thead>
<tr>
<th>TABLE – I</th>
<th>CONCRETE MIX PROPORTIONS AND STRENGTH REQUIREMENTS</th>
<th>ORDINARY CONCRETE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade of Concrete</td>
<td>Total quantity of dry aggregates by volume per 50 Kg. of cement to be taken as the sum of individual volumes of fine &amp; coarse aggregates (Max.)</td>
<td>Proportion of fine Aggregates to Coarse Aggregates</td>
</tr>
<tr>
<td>M-15</td>
<td>220 Litres</td>
<td>Generally 1:2 for fine aggregates to coarse aggregates by volume but subject to an upper limit of 1 : 1.5 and a lower limit of 1:3</td>
</tr>
<tr>
<td>M-20</td>
<td>160 Litres</td>
<td></td>
</tr>
<tr>
<td>M-25</td>
<td>100 Litres</td>
<td></td>
</tr>
</tbody>
</table>

(NOTE : Regarding explanation to the above mix proportions, refer to Table - III of IS : 456).
1.5.4.1.2 In proportioning concrete the quantity of cement shall be determined by actual weight. The quantities of fine and coarse aggregates may be determined by volume, but preferably by weight. If the aggregates are moist, allowance shall be made for bulking in case of volume batching and in accordance with IS : 2386 (Part-III). Allowance shall also be made for surface water present in the aggregates when computing the water content. The amount of surface water shall be determined by one of the field methods described in IS : 2386 (Part-III). All the above data shall be maintained properly to satisfaction of the Engineer.

1.5.4.1.3 The water-cement ratio shall not be more than those specified above. The cement content of any nominal mix proportion specified above shall be increased if the quantity of water in a mix has to be increased to overcome the difficulties of placement and compaction, so that the water-cement ratio specified above for a particular mix is not exceeded. No extra payment shall be made to the Contractor for use of the extra cement.

1.5.4.1.4 If ordinary concrete made in accordance with the proportions given above for a particular grade does not yield the specified strength and fails to satisfy the requirements of 'Acceptance Criteria for concrete' as specified in IS : 456, the cement content shall be increased as directed by the Engineer to obtain a specified strength at no extra cost to the owner. This richer mix shall continue until the Engineer instructs otherwise.

1.5.4.1.5 Ordinary concrete proportioned for a given grade specified above shall not, however, be classified as a higher grade on the ground that the test strengths were found higher than the minimum specified.

1.5.4.2 Controlled concrete:

Controlled concrete shall be used on all concrete works, except where specified otherwise. Controlled concrete for use in plain and reinforced concrete structures shall be in grades M-15, M-20, M-25 etc.

1.5.4.2.1 The mix proportions for all grades of concrete shall be designed to obtain strengths corresponding to the values specified hereinafter for respective grades of concrete. Preliminary tests, as specified in the I.S. code and required by the Engineer, shall be carried out sufficiently ahead of the actual commencement of the work with different grades of concrete made from representative samples of aggregates and the water-cement ratio required to produce a concrete of specified strength and desired workability.

1.5.4.2.2 As a guide to perform the mix design properly, the relationship between water-cement ratio, aggregate to cement ratio, workability and strength of concrete are furnished in Table-II below:
TABLE - II
(FOR GUIDANCE ONLY) MIX
PROPORTIONS (BY WEIGHT) EXPECTED TO GIVE DIFFERENT
DEGREES OF WORKABILITY WITH DIFFERENT WATER-
CEMENT RATIOS AND A SPECIFIED STRENGTH

<table>
<thead>
<tr>
<th>Workability</th>
<th>Water/Cement Ratio</th>
<th>Compressive Strength in Cylinder 28 days Kg/cm²</th>
<th>Ratio by weight of cement to crushed stone aggregate</th>
<th>Ratio by weight of cement to gravel aggregate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>20mm</td>
<td>40mm</td>
</tr>
<tr>
<td>Very slump 0-25 mm</td>
<td>0:04</td>
<td>360</td>
<td>01:04.5</td>
<td>01:05.0</td>
</tr>
<tr>
<td></td>
<td>0:05</td>
<td>290</td>
<td>01:06.5</td>
<td>01:07.4</td>
</tr>
<tr>
<td></td>
<td>0:06</td>
<td>220</td>
<td>01:07.8</td>
<td>01:08.4</td>
</tr>
<tr>
<td></td>
<td>0:07</td>
<td>160</td>
<td>01:08.7</td>
<td>01:08.9</td>
</tr>
<tr>
<td>Low slump 25-50 mm</td>
<td>0:04</td>
<td>360</td>
<td>01:03.5</td>
<td>01:04.0</td>
</tr>
<tr>
<td></td>
<td>0:05</td>
<td>290</td>
<td>01:05.0</td>
<td>01:05.5</td>
</tr>
<tr>
<td></td>
<td>0:06</td>
<td>220</td>
<td>01:06.3</td>
<td>01:07.0</td>
</tr>
<tr>
<td></td>
<td>0:07</td>
<td>160</td>
<td>01:07.4</td>
<td>01:08.0</td>
</tr>
<tr>
<td>Medium Slump 50-100 mm</td>
<td>0:04</td>
<td>360</td>
<td>01:03.1</td>
<td>01:05.6</td>
</tr>
<tr>
<td></td>
<td>0:05</td>
<td>290</td>
<td>01:04.2</td>
<td>01:05.0</td>
</tr>
<tr>
<td></td>
<td>0:06</td>
<td>220</td>
<td>01:05.2</td>
<td>01:06.2</td>
</tr>
<tr>
<td></td>
<td>0:07</td>
<td>160</td>
<td>01:06.2</td>
<td>01:07.0</td>
</tr>
<tr>
<td>High slump 100-175 mm</td>
<td>0:04</td>
<td>360</td>
<td>01:02.5</td>
<td>01:03.3</td>
</tr>
<tr>
<td></td>
<td>0:05</td>
<td>290</td>
<td>01:03.9</td>
<td>01:04.6</td>
</tr>
<tr>
<td></td>
<td>0:06</td>
<td>220</td>
<td>01:04.7</td>
<td>01:05.7</td>
</tr>
<tr>
<td></td>
<td>0:07</td>
<td>160</td>
<td>01:05.5</td>
<td>01:06.5</td>
</tr>
</tbody>
</table>

Notwithstanding anything mentioned herebefore, the maximum total quantity of aggregates by weight per 50 Kg of cement shall not exceed 450 Kg except where otherwise specifically permitted by the Engineer.

1.5.4.2.3 Low The minimum cement content for each grade of concrete shall be as per latest BIS/ IS /CPWD/ NBO code of practice:

1.5.4.2.4 At least 4 trial batches are to be made and 7 test cylinders taken for each batch noting the slump on each mix. These cylinders shall then be properly cured and two cylinders for each mix shall be tested in a testing laboratory approved by the Engineer at 7 days and others at 28 days for
obtaining the ultimate compressive strength. The test reports shall be submitted to the Engineer. The cost of the mix design and testing shall be borne by the Contractor. On the basis of the preliminary test reports for trial mix, a proportion of mix by weight and water-cement ratio will be approved by the Engineer, which will be expected to give the required strength, consistency and workability and the proportions so decided for different grades of concrete shall be adhered to during all concreting operations. If, however, at any time, the Engineer feels that the quality of materials, being used has changed from those used for preliminary mix design, the Contractor shall have to run similar trial mixes to ascertain the mix proportions and consistency. It will be within the competency of the Engineer to reduce the number of trial batches and then number of test specimens mentioned above. Further, the Engineer can also allow adoption of the mixes already tried and found satisfactory, with similar materials, for other jobs at the same site, without any fresh design of the mix.

The mixes once approved must not be varied without prior approval of the Engineer. Should however, the Contractor anticipate any change in the quality of future supply of materials than that has been used for preliminary mix design, he shall inform the same to the Engineer and bring fresh samples sufficiently ahead to carry out fresh trial mixes.

If permitted by the Engineer, Contractor may test concrete cube specimens in place of cylinder specimens.

1.5.4.2.5 In designing the mix proportions of concrete, the quantity of both cement and aggregate shall be determined by weight. The Engineer may allow the quantity of aggregates to be determined by equivalent volume basis after the relationship between the weight and volume is well established by trial and the same shall be in calibrated tanks or weighed. All measuring equipment shall be maintained in a clean and serviceable condition, and their accuracy periodically checked.

1.5.4.2.6 To keep the water-cement ratio to the designed value, allowance shall be made for the moisture contents in both fine and coarse aggregates and determination of the same shall be made as frequently as directed by the Engineer. The determination of moisture contents shall be according to IS:2386 (Part-III).

1.5.5 STRENGTH REQUIREMENTS:

1.5.5.1 Where ordinary portland cement conforming to IS : 269 or Portland blast furnace slag cement conforming to IS : 455 is used, the compressive strength requirements for various grades of concrete shall be as shown in Table - IV.
hereinafter. Where rapid hardening Portland cement is used, the 28 day com-pressive strength requirements specified in Table-IV shall be met in 7 days. The strength requirements specified in Table-IV shall apply to both controlled concrete and ordinary concrete.

1.5.5.2 The acceptance of strength of concrete shall be as per Clause 5.4 'Sample size and Acceptance Criteria' of IS : 456, subject to stipulations and/or modifications stated elsewhere in this specification.

1.5.5.3 Concrete work found unsuitable for acceptance shall have to be dismantled and replacement to be done as per specification by the contractor. No payment for the dismantled concrete, the relevant formwork and reinforcement, embedded fixtures etc. wasted in the dismantled portion shall be made. In the course of dismantling, if any damage is done to the embedded items or adjacent structures, the same shall be made good free of charge by the Contractor to satisfaction of the Engineer.

1.5.5.4 Compressive strength requirement for different grades of concrete as specified in Table - IV with reference to 15 cm diameter x 30 cm high cylinder specimen or 15 cm x 15 cm x 15 cm cube specimen, as the case may be, shall have to be satisfied. Requirements for preliminary tests and works tests are specified separately.

**TABLE - IV STRENGTH REQUIREMENTS OF CONCRETE**

<table>
<thead>
<tr>
<th>Grade of Concrete</th>
<th>For 15cm diameter x 30cm high cylinder specimen</th>
<th>For 15cm x 15cm x 15 cm cube specimen</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Preliminary Test</td>
<td>Works Test</td>
</tr>
<tr>
<td></td>
<td>Preliminary Test</td>
<td>Works Test</td>
</tr>
<tr>
<td>M - 15</td>
<td>160</td>
<td>120</td>
</tr>
<tr>
<td></td>
<td></td>
<td>200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>150</td>
</tr>
<tr>
<td>M - 20</td>
<td>208</td>
<td>160</td>
</tr>
<tr>
<td></td>
<td></td>
<td>260</td>
</tr>
<tr>
<td></td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>M - 25</td>
<td>256</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>320</td>
</tr>
<tr>
<td></td>
<td></td>
<td>250</td>
</tr>
</tbody>
</table>

Other requirements of concrete strength as may be desired by the Engineer shall be in accordance with Indian Standard IS : 456.

1.5.5.5 In exceptional circumstances, the Engineer may accept a concrete of lower strength than specified and which is otherwise unacceptable according to the 'Acceptance Criteria' of IS : 456, provided the strength is never less than 80% of the specified strength. All concrete having a strength less than 80% of that specified shall always be rejected.

With permission of the Engineer, for any of the above mentioned grades of concrete, if the water has to be increased in special cases, cement shall also be increased proportionately to keep the ratio of water to cement same as
adopted in trial mix design for each grade of concrete. No extra payment for the additional cement will be made.

1.5.6 WORKABILITY :

1.5.6.1 The workability of the concrete shall be checked at frequent intervals by slump test. Where facilities exist and if required by the Engineer, alternatively, the compacting factor test in accordance with IS : 1199 shall be carried out.

1.5.6.2 The degree of workability necessary to allow the concrete to be well consolidated and to be worked into the corners or formwork and round the reinforcement to give the required surface finish shall depend on the type and nature of structure and shall be based on experience and tests. The preferred limits of consistency for various type of structures, are as specified in the following Table - V :

**TABLE - V : LIMITS OF CONSISTENCY**

<table>
<thead>
<tr>
<th>Degree of workability</th>
<th>Slump in mm with standard cone as per IS : 1199</th>
<th>Use for which concrete is suitable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very low</td>
<td>Min. 0, Max. 25</td>
<td>Vibrated concrete in roads or other large sections.</td>
</tr>
<tr>
<td>Low</td>
<td>25, 50</td>
<td>Mass concrete foundations without vibration, simple reinforced sections with vibration.</td>
</tr>
<tr>
<td>Medium</td>
<td>50, 100</td>
<td>Normal reinforced wall without vibration and heavily reinforced section with vibration. Sections with congested reinforcement not normally suitable for vibration.</td>
</tr>
<tr>
<td>High</td>
<td>100, 150</td>
<td></td>
</tr>
</tbody>
</table>

(Note : Notwithstanding the above, the slump to be obtained for work in progress shall be as per direction of the Engineer).

1.5.7 LOAD TEST :

Load test of structural members may be required by the Engineer when the strength of job control cylinders/cubes fall below the required strength and is not acceptable as per ‘Acceptance Criteria’ of IS : 456. If the load testing is decided by the Engineer, the member under consideration shall be subjected to a super imposed load equal to one and a quarter (1.25 ) times the specified superimposed load used for design and this load shall be maintained for a period of 24 hours before removal. The detailed procedure of the test is to be decided by the Engineer.

1.5.7.1.1 If the member shows evident failure, such changes as are necessary to make the structure adequately strong shall be made by the Contractor free of cost to the owner. If, on the other hand, the failure becomes evident, the Engineer, under special circumstances (with the approval of the designer), can
retain the portion of the structure under test, provided suitable modification for strengthening and/or dispersion of design load is feasible. Cost of such modification or dispersion of load shall be borne by the Contractor.

1.5.7.1.2 The member shall be deemed to have passed the test if the maximum deflection at the end of 24 hours does not exceed the deflection given by the following expression:

\[ D = 0.001 \frac{L^2}{12} t \]

Where

D = deflection,

L = Length of the member and

t = depth of the member.

If the deflection exceeds 'D' in the above formula and the member does not recover at least 75% of observed deflection with 24 hours of removal of load, the test loading shall be repeated after a lapse of at least 72 hours and the member shall be considered to have failed to pass the test, if the recovery after the second test loading is not at least 75% of the maximum deflection shown during the second test.

1.5.7.2 Load tests shall not be made until the expiry of 56 days of effective hardening of the concrete.

1.5.7.3 The entire cost of load testing shall be borne by the Contractor. If a portion of the structure is found to be unacceptable, it shall be dismantled and replaced by a fresh structure as per specification. The cost of dismantling and the cost of concrete, formwork and reinforcement involved in the dismantling, any damage is done to the embedded items and or other adjacent structures, the same shall be made good free of charge by the Contractor to the satisfaction of the Engineer.

1.5.8 WORKMANSHIP:

General:

All workmanship shall be according to the latest and best possible standards.

Before starting a pour the contractor shall obtain the approval of the Engineer in a 'Pour card' maintained for this purpose. He shall obtain complete instructions about the material and proportion to be used, slump workability, quantity of water per unit of cement, number of test cylinders to be taken, type of finishing to be done, any admixture to be added etc.
1.5.8.1 Concrete :

1.5.8.1.1 Mixing of Concrete:

The proportions of fine and coarse aggregate, cement and water shall be as determined by the preliminary tests or according to fixed proportions in case of ordinary concrete and shall always be approved by the Engineer. The quantities of fine and coarse aggregates shall be determined as specified hereinbefore. The quantity of cement shall always be determined by weight. The water shall be measured accurately after giving proper allowance for surface water present in the aggregate for which regular check shall be made by the Contractor. Due allowance shall be made for bulking in case of volume hatching in accordance with IS : 2386 (Part - III).

Concrete shall always be mixed in a mechanical mixer unless specifically approved by the Engineer for concrete to be used in unimportant structures. The water shall not be poured into the drum of the mixer until all the cement and aggregates constituting the batch are already in the drum and mixed for at least one minute. Mixing of each batch shall be continued until the mix is uniform in colour and consistency, but in no case shall mixing be done for less than two (2) minutes and at least forty (40) revolutions after all the materials and water are in the drum. When absorbent aggregates are used or when the mix is very dry, the mixing time shall be extended as may be directed by the Engineer. Mixers shall not be loaded above their rated capacity as this prevents thorough mixing.

The entire contents of the drum shall be discharged before the ingredients for the next batch are fed into the drum. No partly set remixed or excessively wet concrete shall be used and it shall be immediately removed from site. Each time the work stops, the mixer shall be thoroughly cleaned and when the next mixing commences, the first batch shall have 10% additional cement at no extra cost to the Owner to allow for loss in the drum.

When hand mixing is permitted by the Engineer for concrete to be used in unimportant structures it shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. In case of hand mixing, extra cement @ 10% shall be added to each batch at no extra cost to the Owner.

1.5.8.1.2 Conveying Concrete:

Concrete shall be handled and conveyed from the place of mixing to the place of final laying as rapidly as practicable, by approved means, before the initial setting of the cement starts. Concrete should be conveyed in such a way as will prevent segregation or loss of any of the ingredients. If segregation does
occur during transport, the concrete shall be remixed. During very hot or cold weather, if directed by the Engineer, concrete shall be transported in deep containers which will reduce the rate of evaporation and loss of heat. Conveying equipments for concrete shall be well maintained and thoroughly cleaned before commencement of concrete mixing. Such equipment shall be kept free from set concrete.

1.5.8.1.3 Placing Concrete:

Formwork and reinforcement shall be approved in writing by the Engineer before concrete is placed. The forms shall be well wetted and all shavings, dirt and water that may have collected at the bottom shall be removed before concrete is placed. Concrete shall be deposited in its final position without segregation, re-handling or flowing. The interval between adding the water to the dry materials in the mixer and the completion of the final placing inclusive of compaction of the concrete shall be well within the initial setting time for the particular cement in use or as directed by the Engineer. As far as possible, concreting shall be placed in the formwork by means approved by the Engineer and shall not be dropped from a height or handled in a manner which may cause segregation. Any drop over 180 cm shall have to be approved by the Engineer. Once the concrete is deposited in its final position, it shall not be disturbed.

After the concrete has been placed, it shall be spaded and thoroughly compacted by approved mechanical vibration to a maximum subsidence without segregation and thoroughly worked around reinforcement or other embedded fixtures into the correct form and shape. Vibrators shall not be used for pushing and shovelling concrete into adjoining areas. Vibrators must be operated by experienced men and over-vibration shall not be permitted. Hand tamping in some cases may be allowed subject to the approval of the Engineer. Care must be taken to ensure that the inserts, fixtures, reinforcement and formwork are not displaced or distorted during placing of concrete. No concrete shall be placed in open, while it rains. If there has been any sign of washing of cement and sand, the concrete shall be removed immediately. Suitable precautions shall be taken in advance to guard against rains leaving the fresh concrete unattended. No accumulation of water shall be permitted on or around freshly laid concrete. Slabs, beams and similar members shall be poured in one operation normally. In special circumstances, with the approval of the Engineer, these can be poured in horizontal layers not exceeding fifty (50) cm. in depth. When poured in layers, it must be ensured that the under layer is not already hardened.
Blending of under layer, if any, shall be effectively removed. Moulding, throating, drip course etc. shall be poured as shown on the drawing or as desired by the Engineer. Holes shall be provided and bolts, sleeves, anchors, fastenings or other fixtures shall be embedded in concrete as shown on the approved drawings or as directed by the Engineer. Any deviation therefrom shall be set right by the Contractor at his own expenses as instructed by the Engineer.

1.5.8.1.4 Construction Joints :

When the work is to be interrupted, the concrete shall be rebated at the joint to such shape and size as may be required by the Engineer or as shown on the drawing. All vertical construction joints shall be made with stop boards, which are rigidly fixed and slotted to allow for the passage of the reinforcing steel. If desired by the Engineer, keys and/or dowel bars shall be provided at the construction joints. In the case of water retaining structures, water stop of approved material shall be provided if so specified on the drawing or desired by the Engineer. Construction joints shall be provided in positions as shown or described on the drawings. Where it is not described, the joints shall be in accordance with the following:

In a column, the joint shall be formed about 75 mm below the lowest soffit of the beams framing into it.

Concrete in a beam shall be placed throughout without a joint, but if the provision of a joint is unavoidable, the joint shall be vertical and at the middle of the span. A joint in a suspended floor slab shall be vertical at the middle of the span and at right angle to the principal reinforcement.

In forming a joint, concrete shall not be allowed to slope away to a thin edge. The locations of construction joints shall be planned by the Contractor well in advance of pouring and have to be approved by the Engineer.

Before fresh concrete is placed, the cement skin of the partially hardened concrete shall be thoroughly removed and surface made rough by hacking, sand blasting, water jetting, air jetting or any other method as directed by the Engineer. The rough surface shall be thoroughly wetted for about two hours and shall be dried and coated with 1:1 freshly mixed cement sand slurry immediately before placing the new concrete. The new concrete shall be worked against the prepared surface before the slurry sets. Special care shall be taken to see that the first layer of concrete placed after a construction joint is thoroughly rammed against the existing layer. Cold joints during pour shall be treated with 1:1 freshly made cement sand slurry only after removing all loose materials.
1.5.8.1.5 Protection and Curing of Concrete:

Newly placed concrete shall be protected by approved means from rain, sun and wind. Concrete placed below the ground level shall be protected from falling earth during and after the placing. Concrete placed in ground containing deleterious substances shall be kept free from contact with such ground or with water draining from such ground during placing of concrete and for a period of at least three days or as otherwise instructed by the Engineer. The ground water around newly poured concrete shall be kept to an approved level by pumping or other approved means of drainage. Adequate steps shall be taken to prevent floatation or flooding. Steps, as approved by the Engineer, shall be taken to protect immature concrete from damage by debris, excessive loading, vibration, abrasion, mixing with earth or other deleterious materials etc. that may impair the strength and durability of the concrete.

As soon as the concrete has hardened sufficiently for the surface to be marked, it shall be covered either with sand, hessian, canvas or similar materials and kept continuously wet for at least seven (7) days after final setting. This period may be extended, at the discretion of the Engineer, upto fourteen (14) days.

1.5.8.1.6 Control Tests On Concrete:

For the concrete of a particular specified strength, at least six (6) test cubes/cylinders for each type of mix. shall be taken by the Contractor for each 8 hours or less work for each medium sized mixing plant. If the volume of concrete poured is less than 20 M$^3$ on any day per mixing plant, the Engineer may exempt or reduce the number of test specimens at his discretion based on the test report. The sampling of concrete, making the test specimens, curing and testing procedure shall be as specified in IS : 456. The test specimens shall be 15 cm dia and 30 cm high. The Contractor shall get the specimens tested in a laboratory approved by the Engineer and submit to the Engineer the test results in triplicate within three (3) days of the test. The contractor shall carryout the sampling and testing according to the provisions of this specification at his own cost. No payment shall also be made for the concrete used in specimen.

To control the consistency of concrete from mixing plant, slump tests shall be carried out by the Contractor free of charge every two hours or as directed by the Engineer. The amount of mixing water shall not be changed without approval of the Engineer. Slumps corresponding to the test cylinders shall be recorded for reference.
Before commencing the work or during the progress of the work, the Engineer, if so desires, may order tests to be carried out on cement, sand or coarse aggregates, water, reinforcing steel or transverse tests in accordance with ISI recommendations. The Engineer can suspend the work during the testing of any doubtful material. No claim for any consequent loss arising out of such suspension shall be entertained.

For testing concrete, if permitted by the Engineer, cube specimens may be tested in place of cylinder specimens.

1.5.8.2 Reinforcement:

1.5.8.2.1 Shop Drawings - Bar Bending Schedules:

The Contractor shall prepare and furnish to the Owner bar bending schedules with working drawings for all R.C.C. work for review by the Engineer.

1.5.8.2.2 Cleaning:

All steel for reinforcement shall be free from loose scale, oil, grease, paint or other harmful matters immediately before placing the concrete.

1.5.8.2.3 Bending:

Unless otherwise specified, reinforcing steel shall be bent in accordance with procedure specified in IS : 2502 or as approved by the Engineer. Bends and shapes shall comply strictly with the dimensions in the approved Bar Bending Schedule. Bending schedule shall be re-checked by the Contractor before bending and he shall be entirely responsible for its correctness. Bar Correctly bent shall only be used.

No reinforcement shall be bent, when a position in the work without approval of the Engineer, whether or not it is partially embedded in concrete. Bars shall not be straightened in a manner that will injure the material. Rebending can be done only if approved by the Engineer. Reinforcement bars shall be bent by machine or other approved means producing a gradual and even motion. All the bars shall be cold bent unless otherwise approved. Bending hot at a cherry-red heat (not exceeding 845°C) may be allowed in very exceptional cases except for bars whose strength depends on cold working. Bars bent hot shall not be cooled by quenching.
1.5.8.2.4 Placing in Position:

All reinforcements shall be accurately fixed and maintained in position as shown on the drawings by such approved means as mild steel chairs and/or concrete spacer block. Bars intended to be in contact, at crossing points, shall be securely bound together at all such points by No. 20 G annealed soft iron wire or by tack welding as may be directed by the Engineer. Binders and the like shall tightly embrace the bars with which they are intended to be in contact and shall be securely held. The vertical distance between successive layers of bars shall be maintained by provision of mild steel spacer bars. They should be so spaced that the main bars do not sag perceptibly between adjacent spacers.

Welding by gas or electricity may be permitted by the Engineer under suitable conditions and with suitable safeguards in accordance with relevant Indian Standards for welding of mild steel bars used in reinforced concrete construction, Butt welding between ends of a bar in a line, whereby stress is transferred across the section may be allowed for mild steel bars only. In the case of bars of mild steel, which have there strength increased by cold twisting (like cold twisted bars), the stress at the weld shall be limited to the strength of mild steel before cold twisting and the additional strength obtained by cold twisting shall be ignored at and near the weld. As a consequence, if any additional steel is required to be provided in the member, it shall be to the Contractor's account.

The placing of reinforcements shall be completed well in advance of concrete pouring. Immediately before pouring, the reinforcement shall be examined by the Engineer for accuracy of placement and cleanliness and necessary corrections as directed by him shall be carried out. The cover for concrete over the reinforcements shall be as shown on the approved drawings unless otherwise directed by the Engineer. Where concrete blocks are used for ensuring the cover and positioning reinforcement, they shall be made of mortar not leaner than one (1) part cement to two (2) parts sand by volume and cured for at least seven (7) days. The sizes and locations of the concrete blocks shall be approved by the Engineer. Laps and anchorage lengths of reinforcing bars shall be in accordance with IS : 456, unless otherwise specified. If the bars in a lap are not of the same diameter, the smaller will guide the lap length. The laps shall be staggered as far as practicable and as directed by the Engineer.
1.5.8.3 FORMWORK:

1.5.8.3.1 General:

If it is so desired, the Contractor shall prepare, before commencement of actual work, design and drawings for formwork and centering and get them approved by the Engineer. The formwork shall conform to the shape, lines and dimensions as shown on the drawings.

The centering shall be true and rigid and thoroughly braced both horizontally and diagonally. The forms shall be sufficiently strong to carry without undue deformation, the dead weight of the concrete as a liquid as well as working load. Where the concrete is vibrated, the formwork shall be strong enough to withstand the effects of vibration without appreciable deflection, bulging, distortion or loosening of its components. The joints in the formwork shall be sufficiently tight to prevent any leakage of mortar. The formwork shall be such as to ensure a smooth uniform surface free from honeycombs, air bubbles, bulges, fins and other blemishes. Any blemish or defect found on the surface of the concrete must be brought to the notice of the Engineer immediately and rectified free of charge as directed by him. To achieve the desired rigidity, tie bolts, spacer blocks, tie wires and clamps as approved by the Engineer shall be used but they must in no way impair the strength of concrete or leave stains or marks on the finished surface. Where there are chances of these fixtures being embedded, only mild steel or concrete of adequate strength shall be used. Bolts passing completely through liquid retaining walls/slabs for the purpose of acquiring and aligning the formwork should not be used unless effective precautions are taken to ensure water tightness after removal.

For exposed interior and exterior concrete surfaces of beams, columns, and walls, plywood or other approved forms, thoroughly cleaned and tied together with approved corrosion-resistant devices shall be used. Rigid care shall be exercised in ensuring that all columns are plumb and true and thoroughly cross braced to keep them so. All floor and beam centering shall be crowned not less than 8 mm in all directions for every 5 meters span. Unless described on the drawing or elsewhere to the contrary, beveled strips 25 mm by 25 mm shall be provided, without any extra charge, to form angles and in corners of column and beam boxes for chamfering of corners. Temporary openings for cleaning, inspection and for pouring concrete shall be provided at the base of vertical forms and at other places, where they are necessary and as may be directed by the Engineer. The temporary openings shall be so formed that they can be conveniently closed when required and must not leave any mark on the concrete.

1.5.8.3.2 Cleaning and Treatment of Forms:

All forms shall be thoroughly cleaned of old concrete, wood shavings, saw dust, dirt and dust sticking to them before they are fixed in position. All rubbish, loose concrete, Chippings, shavings, saw dust, etc., shall be scrupulously removed from the interior of the forms before the concrete is poured. Along with wire brushes, brooms etc., compressed air jet and/or water jet shall be kept handy for the cleaning, if directed by the Engineer. Before shutter is placed in position, the form surface in contact with concrete shall be treated with approved non-staining oil composition. Care shall be taken that the oil or composition does not come in contact with reinforcing steel or existing concrete surfaces. They shall not be allowed to accumulate at the bottom of the shuttering.

The formwork shall be so designed and erected that the forms for slabs and the sides of beams, columns and walls may be removed first, leaving the shut
tering to the soffits of beams and their supports in position. Re-propping of beams shall not be done except with the approval of the Engineer, and props can be reinstated in anticipation of abnormal conditions. If formwork for column is erected for the full height of the columns, one side shall be left open and built up in sections as placing of concrete proceeds. Wedges, spacer bolts, clamps or other suitable means shall be provided to allow accurate adjustment of the formwork and to allow it to be removed gradually without jarring the concrete.

1.5.8.3.3 Removal of Forms:

The Contractor shall record on the drawing or in other approved manner, the date on which the concrete is placed in each part of the work and the date on which the formwork is removed there from and have this record checked and countersigned by the Engineer. The Contractor shall be responsible for the safe removal of the formwork, but the Engineer may delay the time of removal if he considers it necessary. Any work showing signs of damage through premature removal of formwork or loading shall be entirely re-constructed without any extra cost to the Owner.

Forms for various types of structural components shall not be removed before the minimum specified days as shown below (Table-VI) which shall also be subject to the approval of the Engineer:

TABLE - VI

<table>
<thead>
<tr>
<th>Parts of Structure</th>
<th>Ordinary Portland Cement Concrete</th>
<th>Rapid Hardening Portland Cement Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Temperature</td>
<td>Temperature</td>
</tr>
<tr>
<td></td>
<td>Above 40°C 40°C to 20°C 20°C to 5°C Below 5°C</td>
<td>Above 40°C 40°C to 20°C 20°C to 5°C Below 5°C</td>
</tr>
<tr>
<td>Days</td>
<td>Days</td>
<td>Days</td>
</tr>
<tr>
<td>a) Columns &amp; walls</td>
<td>2 1 1</td>
<td>Do not remove forms until site cured test cylinders/cubes develop</td>
</tr>
<tr>
<td>b) Beams sides</td>
<td>3 2 3</td>
<td></td>
</tr>
<tr>
<td>c) Slab, 125mm thick or less</td>
<td>10 7 8</td>
<td></td>
</tr>
<tr>
<td>d) Slab, 125mm thick or less &amp; soffit of minor beams</td>
<td>18 14 16</td>
<td></td>
</tr>
<tr>
<td>e) Soffit of main beams</td>
<td>24 21 22</td>
<td></td>
</tr>
</tbody>
</table>
Where exposed surfaces of a concrete can be effectively sealed to prevent loss of water, the periods specified for temperature above 40°C can be reduced to those for the temperature range of 20°C to 40°C subject to approval of the Engineer. Before removing any formwork, the Contractor must notify the Engineer well in advance to enable him to inspect the concrete, if he so desires.

1.5.8.3.4 Tolerance:

The formwork shall be so made as to produce a finished concrete, true to shape, lines, levels, plumb and dimensions as shown on the drawings subject to the following tolerances unless otherwise specified in this specification or drawings or directed by the Engineer.

For:

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Sectional dimension</td>
<td>-</td>
<td>5 mm</td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td>Plumb</td>
<td>-</td>
<td>1 in 1000 of height</td>
<td></td>
</tr>
<tr>
<td>c)</td>
<td>Levels</td>
<td>-</td>
<td>3 mm before any deflection has taken place.</td>
<td></td>
</tr>
</tbody>
</table>

1.5.8.3.5 Re-use of Forms:

Before re-use, all forms shall be thoroughly scraped, cleaned, joints, etc. examined and when necessary repaired and inside surface treated as specified hereinbefore. Formwork shall not be used/re-used, if declared unfit or unserviceable by the Engineer.
1.5.8.3.6 Classification:

Ordinary:
These shall be used in places where ordinary surface finish is required and shall be composed of steel and/or approved good quality seasoned wood.

Plywood:
These shall be used in exposed surfaces, where a specially good finish is required and shall be made mostly of approved brand of heavy quality plywood to produce a perfectly level, uniform and smooth surface. Re-use may only be permitted after special inspection and approval by the Engineer. He may also permit utilisation of used plywood for the 'ordinary' class.

1.5.8.4 EXPOSED SURFACES:

1.5.8.4.1 Interior:
Imperfect surfaces, where strength is not the criteria shall be patched and rubbed smooth with carborundum stone. Immediately after the formwork is stripped off, fins and projections shall be removed and the concrete surface affected thereby shall be rubbed smooth to satisfaction of the Engineer.

1.5.8.4.2 Exterior:
Imperfect surfaces shall not be patched but shall be repaired by removal and replacement of the member or as directed by the Engineer. Small voids shall be filled with 1:2 cement mortar pressed into holes and floated smooth. Plastering and steel trowelling of surfaces shall not be allowed except in exceptional cases as may be directed by the Engineer. Fins and projections shall be treated as 2.5.8.4.1 above.

1.5.8.5 Anchor Bolts, Anchors, Openings, Sleeves, Inserts & other Built-in-fixtures:

The contractor shall provide openings, grooves, chases etc. in concrete work as required for erection of equipment & structures. He shall build into concrete work all the materials noted below and shall embed and secure the same as and when required. The material shall be of best quality available of approved manufacture and shall be upto satisfaction of the Engineer. Exposed surfaces of embedded materials are to be painted with one coat of approved anti-corrosive paint and/or bituminous paint without any extra cost to the owner.

Materials to be embedded:

i) Inserts, hangers, anchors, opening frames, manhole cover, frames,
floor clips, sleeves and conduits

ii) Anchor bolts and plates for machinery, equipment and for structural steel work;

iii) Dowel bars etc. for concrete work;

iv) Lugs or plugs for door and window frames occurring in concrete work,

v) Flashing and jointing in concrete work;

vi) Any other built-in-fixtures as may be required.

Correct location, exact alignment etc. of all these shall be entirely the responsibility of the Contractor.

1.5.8.6 Joints etc.:

1.5.8.6.1 Expansion and Isolation Joints:

Expansion joints in concrete structures shall be provided at specified places as indicated on the drawings. The materials and types of joints shall be as specified below. In case of liquid retaining structures, additional precaution shall be taken to prevent leakage of liquids as may be specified on the drawings or as directed by the Engineer.

All materials shall be procured from reliable manufacturers and shall have approval of the Engineer. The Engineer may demand test certificates for the materials and/or get them tested.

1.5.8.6.2 Bitumen Board:

Bitumen impregnated fibre boards of approved manufacture as per IS : 1838 shall be used as fillers for expansion joints. It must be durable and waterproof. It shall be compressive and possess a high degree of recovery after compression is released. At the exposed end, the joint shall be sealed with approved sealing compound to a depth of 25 mm after application of an approved primer. The sealing compound and the primer shall be applied as specified by the manufacturer.

1.5.8.6.3 Bitumen Compound:

The gap for expansion joints shall be thoroughly cleaned and the bitumen compound laid as per manufacturer's specifications. The compound to be used shall be of approved manufacture and shall conform to the requirements of IS : 1834.

1.5.8.6.4 Separation Joints:

Strong and tough alkathene sheet or equivalent of about 1 mm thickness as
approved by the Engineer shall be used. It shall be stuck by an approved
sticker to the cleaned surface of the already set concrete to cover it fully.
Fresh concrete shall be laid against the sheet, care being taken not to damage
the sheet in any way.

1.5.8.6.5 Rubber Pad:

Hard foundation quality rubber pads of required thickness and shape shall be
put below machine or other foundations where required as shown on the draw-
ings or as desired by the Engineer. The rubber shall be of best quality of ap-
proved manufacture, durable, capable of absorbing vibration and must be
chemically inert when in contact with moist or dry earth under normal condi-
tions.

1.5.8.7 Grouting:

1.5.8.7.1 Pressure Grouting:

Previous rock, fissures etc. under foundations shall be grouted and sealed, if
required. Grout shall be composed of cement and water, except that for wider
seams, sand or 6 mm down stone chips may have to be used in the mixture as
directed by the Engineer. The mix for grouting shall be 1 part cement and 1
part sand. The location and depth of grout holes shall be as directed by the
Engineer. Grout shall be placed at pressures upto 14 Kg./Cm$^2$ or as required
for approved grouting machine.

1.5.8.8 Precast Concrete:

The specification for precast concrete will be exactly similar as for the cast-in-
place concrete described hereinafter. All precast work shall be carried out in a
yard made for the purpose. This yard shall have a hard and leveled platform
made of concrete or grouted brick soling finished smooth with neat cement
plaster overlaid by a layer of G.I. plain sheets and shall have curing tank and
such other facilities. The moulds shall preferably be of steel or of wood lined
with G.I. sheet metal. The yard shall preferably be fenced.

Lifting hooks shall be embedded in correct position of the unit to facilitate erec-
tion, even though they may not be shown on the drawings and shall be burnt
off and finished after erection.

Pre-cast concrete planks after 28 days' of casting and curing ready for erection
shall be transported to site by suitable means approved by the Engineer.
All care shall be taken that no damage occurs during transportation. All adjustments, leveling and plumbing shall be done as per instruments, materials and men to the Engineer for checking the proper erection of the pre-cast units. The joint between pre-cast blanks shall be pointed with 1:2 cement : sand mortar where called for on the drawing.

1.5.9 WATERPROOFING OF CONCRETE STRUCTURES:

The materials and design shall conform to the respective I.S. Code wherever applicable. The Engineer’s approval to the materials shall be obtained by the Contractor before procurement. If desired by the Engineer, test certificates for the materials shall be submitted by the Contractor and samples for testing by the Purchaser shall be supplied free. The materials shall be of best quality available indigenously, fresh and thoroughly clean.

1.5.9.1 Ribbed Rubber:

The material must be very durable and tough. The ribs shall be sufficient to ensure bond with concrete. The width shall be minimum 100 mm and thickness minimum 3 mm. The rubber water stop must be used in long lengths to avoid splicing as far as possible. Each shall have at least 230 mm overlaps and stuck with a reliable sticker compound or vulcanised.

1.5.9.2 PVC Sealing Strips:

PVC. sealing strips shall be used for Expansion joints. The minimum thickness of PVC. sealing strips will be 5 mm and the minimum width 150 mm. The actual size and shape will have to be specified in drawings. The material should be of good quality Polyvinyl chloride highly resistant to tearing, abrasion and corrosion as well as to chemicals likely to come in contact with during use. The physical properties will generally be as follows:

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sp. Gr.</td>
<td>1.3 to 1.35</td>
</tr>
<tr>
<td>Shore hardness</td>
<td>60 A to 80 A</td>
</tr>
<tr>
<td>Tensile strength</td>
<td>100 - 150 Kg/Cm²</td>
</tr>
<tr>
<td>Min. safe continuous Temp.</td>
<td>70°C</td>
</tr>
<tr>
<td>Ultimate elongation</td>
<td>Not less than 275%</td>
</tr>
</tbody>
</table>

1.5.9.3 G.I. Strips:

G.I. Strips, to be used in construction joints, shall be minimum of 22 gauge & 230 mm in width. It shall be strong and durable. Longest lengths available
shall only be procured. At joints strips shall be lapped 150 mm and brazed thoroughly to prevent any leak. These shall be placed in position very securely so as not to get dislodged or distorted during placing of concrete.

1.5.9.4 Water proofing Admixtures:

1.5.9.4.1 In Concrete:

The admixture shall be the right variety of "Lilax, Silvicon, ICICO" or equivalent water proofing cement additive shall be as far as possible free from aggressive chemicals like chlorides, sulphides etc. which can cause corrosion of steel reinforcement in R.C.C.

1.5.9.4.2 In Plaster:

The concrete surface, to be plastered, shall be hacked to Engineer's satisfaction. The plaster shall be made of cement, sand and the approved waterproofing admixture as per manufacturer's specification. The admixture shall be 'IMPERMO' or equivalent as approved by the Engineer. If desired by the Engineer, the Contractor shall have the work supervised by the manufacturer's supervisor at no extra cost to the owner.

1.5.9.5 Bituminous Coating:

Surface to be waterproofed shall be absolutely dry, clean and dust free. The surface shall be completely coated with hot coal tar pitch as per IS: 216 (not heated above 375°F) using not less than 2 Kg per Sq.M. or with hot asphalt i.e. bitumen according to IS : 73 (not heated above 400°F) using not less than 1.5 Kg per Sq.M. When the first coat has completely dried up and passed by the Engineer, the second coat shall be applied in the same manner using not less than 1.25 Kg per Sq.M. in case of coal tar and 1 Kg per Sq.M. in case of asphalt. Immediately after application of the second coat and before it is dried up, sand shall be spread on the surface to cover it completely. Sufficient time shall be allowed after spreading of sand before backfilling is done in order to allow the final coat to dry up completely. Coal tar or asphalt to be used shall be of approved manufacture and of the best quality available.

1.5.9.6 Bitumen Felt:

If specified or desired by the Engineer, structures shall be made damp-proof by courses of bitumen felt and blown bitumen. The Contractor shall entrust the work to one of the well known expert firms approved by the Engineer. The material shall conform to IS : 1322 and the workmanship to IS : 1609. The bitumen felt shall be of hessian based. If demanded by the Engineer, tests as specified in IS Codes shall be organised by the Contractor without charging any extra to the Purchaser.
Cleaning the surface, keeping it dry, providing necessary corner fillets and cement rendering and cutting chases shall be carried out. Protective brickwork, concrete sub-bases or walls are to be included in the bid.

The specification shall cover laying the damp-proof course on the outside and inside of the walls and bases of structures. Unless otherwise specified elsewhere, a 20 years guarantee for perfect performance shall be given by the Contractor individually and collectively.

1.5.9.7 Damp-Water Proofing:

Multiple layer damp-water proofing treatment for basement and structure below G.L. shall be done in accordance with IS : 1609 and 3067. The type of treatment shall depend upon the depth of the structures below subsoil water level and shall be as shown on the drawing or as decided by the Engineer.

1.5.9.8 Other admixture in Concrete:

The Engineer may at his discretion instruct the Contractor to use any admixture in the concrete.

1.5.9.9 Acceptance of Structures:

1.5.9.9.1 Inspection:

Immediately after stripping the formwork, all concrete shall be carefully inspected and any defective work or small defects either removed or made good before concrete has thoroughly hardened.

1.5.9.9.2 In case of doubt regarding the grade of concrete used either due to poor workmanship or based on results of cube strength tests, compressive strength tests of concrete on the basis of Core Test (2.5.9.9.3) and/or Load Test (2.5.9.9.8) may be carried out.

1.5.9.9.3 Core Test:

1.5.9.9.4 The points from which cores are to be taken and the number of cores required shall be at discretion of the Engineer-in-charge and shall be representa-tive of the whole of concrete concerned. In no case, however, shall fewer than three cores be tested.
1.2.5.9.9.5 Cores shall be prepared and tested as described in IS : 516 - 1959.

1.5.3.9.6 Concrete in the member represented by a core test shall be considered acceptable if the average equivalent cube strength of the cores is equal at least 85 percent of the cube strength of the grade of concrete specified for the corresponding age and no individual core has a strength less than 75%.

1.5.9.9.6 In case the core test results do not satisfy the requirements of 2.5.9.9.6 or where such tests have not been done, Load Test (2.5.9.9.8) may be resorted to.

1.5.9.9.7 Load tests on Parts of Structures:

1.5.9.9.8 Load tests should be carried out as soon as possible after expiry of 28 days from the time of placing of concrete.

1.5.9.9.10 The structure should be subjected to a load equal to full dead load of the structure plus 1.25 times the imposed load for a period of 24 hours and then the imposed load shall be removed.

Note: Dead load includes self weight of the structural members plus weight of finishes and walls or partitions, if any, as considered in the design.

1.5.9.9.11 The deflection due to imposed load only shall be recorded. If within 24 hours of removal of the imposed load the structure does not recover at least 75% percent of the deflection under superimposed load, the test may be repeated after a lapse of 72 hours. If the recovery is less than 80%, the structure shall be deemed to be unacceptable.

(a) If the minimum deflection in mm, shown during 24 hours under load is less than 40 \( \frac{L^2}{D} \), where \( L \) is effective span in metre and \( D \) is the overall depth of the section in mm, it is not necessary for the recovery to be measured and the recovery provision of 2.5.9.9.11 will not apply.

1.5.9.9.12 Other non-destructive test methods may be adopted, in which case the acceptance criteria shall be agreed upon between the Engineer-in-Charge and the contractor and the tests shall be done under expert guidance.
1.5.9.10 Code of Practice:

All the works shall conform to relevant IS codes/CPWD/NBO/International Standards. A few of them are mentioned below:

IS : 383  -  Specification for coarse and fine aggregates from natural source for concrete.
IS : 432  -  (All parts) - Specifications for mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement.

Part-I :  Mild Steel and medium tensile bars.
Part-II :  Hard drawn steel wire.
IS : 516  -  Methods of tests for strength of concrete.
IS : 1139  -  Hot rolled mild steel and medium tensile steel deformed bars for concrete reinforcement.
IS : 1199  -  Methods of sampling and analysis of concrete.
IS : 1200  -  Method of measurement of building works (All parts)
IS : 1322  -  Specification for bitumen felts for waterproofing and damp proofing.
IS : 1786  -  Specification for cold twisted steel bars for concrete reinforcement.
IS : 1834  -  Specification for hot-applied sealing compounds for joints in concrete.
IS : 2386  -  Methods of test for aggregates for concrete (8 parts)
IS : 2502  -  Code of practice for bending and fixing of bars for concrete reinforcement.
IS : 2751  -  Code of practice for design & construction of pile foundation.
IS : 3067  -  Code of practice of general design details and preparatory work for damp proofing and water proofing of buildings.
IS : 3370  -  (Part-I & II) - Code of Practice for concrete structure for the storage of liquids.
IS : 8041  -  Rapid hardening Portland cement.
1.6  TECHNICAL SPECIFICATION FOR BRICKWORK:

1.6.1 SCOPE:

1.6.1.1 This specification covers the construction of brick masonry in foundations, arches, walls, etc. at all elevations. Only masonry with fly ash bricks of class 7.5 conforming to IS: 12894 is dealt with in this section.

1.6.1.2 The provision of the latest revision of IS : 2212 shall be complied with unless permitted otherwise and any other IS code (latest revision) shall form a part of this specification to the extent it has been referred to or applicable with this specification.

1.6.2 MATERIALS:

1.6.2.1 Bricks:

Bricks shall conform to the requirements of IS : 12894 - Specification for class 7.5 fly ash bricks.

Bricks shall be of uniform deep red, cherry or copper colour, thoroughly burnt, without being vitrified, regular in shape and size and shall have sharp and square sides, edges and parallel faces to ensure uniformity in the thickness of the course of brick-work.

Brick shall be free from cracks, chips, flaws, stones or lumps of any kind. They shall not show any signs of efflorescence either dry or subsequent to soaking in water.

Bricks shall be sound, hard, homogenous in texture and emit a clear ringing sound on being struck.

Bricks shall be of the local standard size. Any other similar size may be accepted but no dimension shall vary more than 3 mm from the accepted size. All bricks which absorb water more than 20% of their own dry weight after being immersed in water for 24 hours shall be rejected.

All bricks shall have to be approved by the Engineer. Any lot of bricks found not upto the specification must be removed from the site immediately at Contractor's own cost. Representative samples of bricks to be used shall be submitted to the Engineer and his approval taken before bulk purchase. The samples shall be kept sealed with the Engineer for future reference and comparison. All bricks supplied shall conform to these approved samples in all respects.

Bricks shall be carefully and systematically stacked at locations as directed in an approved manner. Each stack shall contain equal numbers of bricks preferably not more than 3,000.
1.6.2.2 Water:

Water shall be clean and free from deleterious matter such as oil, acid, alkali, salt and vegetable growth.

1.6.2.3 Cement:

Portland cement conforming to Indian Standard Specification IS: 269 or portland slag cement conforming to IS: 455 latest revision OR PORTLAND POZZOLONA CEMENT CONFIRMING TO is1498 part-1 REVISION shall be used. Cement shall be stored in weather proof sheds on dry platforms and protected from rain and moisture. Cement which has set or partially set shall not be used.

1.6.2.4 Sand:

Sand shall conform to IS: 383, 100% of the sand shall pass through IS. Sieve No. 240 and not more than 15% to 35% through I.S. Sieve no. 30. Sand shall have a fineness modules between 2.1 and 2.5. Sand shall be clean and free from dirt, clay or other impurities.

Percentage of clay or total impurities shall not be more than 5 by weight.

1.6.3 Mortar:

Mortar for brickwork except for half brick or lower thickness walls shall be 1 part cement and 6 parts sand by volume. Mortar for half brick and lower thickness brick walls shall be 1 part cement and 4 parts sand by volume.

The unit of measurement for cement shall be a bag of cement weighting 50 Kg and this shall be taken as 0.035 cu metre. Other ingredients in specified proportions shall be measured in boxes of suitable volume. In case of damp sand, its quantity shall be increased suitably to allow for bulkage. Cement and sand shall be mixed dry thoroughly on clean approved platform and water shall then be added to obtain a mortar of the consistency of a stiff paste, care being taken to add just sufficient water for the purpose.

Mortar shall be used as soon as possible after mixing and within 2 hours after the cement is mixed wet. Mortar unused for more than 2 hours shall be rejected and removed from the site of work. Mixture of lime putty and sand can be kept for a period of 72 hours, provided it is kept damp and not allowed to dry.
1.6.4 WORKMANSHIP:

All workmanship shall be of best standard as approved by the Engineer.

1.6.4.1 Laying:

Bricks shall be soaked in water before use for at least six (6) hours. The Contractor shall provide tanks of sufficient capacity to allow the specified immersion. Bricks shall be laid in water by hand and not thrown. The bricks shall not be too wet at the time of use, as they are likely to slip on the mortar bed and there will be difficulty in ensuring plumbness of the wall.

Bricks shall be laid with a shore joint in full mortar beds and thoroughly slushed up with mortar at every course. Face bricks shall be laid on full mortar beds and have all vertical joints completely filled with mortar. All brickwork shall be plumb, square and true to dimensions shown on drawings and in approved bond.

All brickwork shall be built tightly against columns, floor slabs or other structural parts, around window and door frames with proper distance to permit caulked joint. Where drawings indicate that structural steel column and apardrel beams are to be partly or wholly covered with brickwork, the bricks shall be built closely against all flanges and webs with all spaces between the steel and the brickwork filled solid with setting mortar with not less than 10 mm in thickness.

Bricks shall be laid in joints not more than 12 mm thick; where stucco finish is specified, the joints of brickwork shall be raked to a minimum depth of 10 mm to ensure good bond of stucco with brickwork.
1.6.4.2 Raking out joints:

Joint of brickwork shall be raked out to a depth of 12 mm at the time of laying and face of brickwork shall be kept clear of all mortar.

1.6.4.3 Corbelling Cornices String Courses:

Corbelling shall be effected by 1/4 brick projection for ordinary work and 1/8 brick projection required from consideration of strength.

1.6.4.4 Reinforcing and Anchorage:

For external walls, the anchors in the form of flats or rods from spandrel beams and columns and any other anchoring and reinforcement as shown on drawing shall be adequately embedded in the masonry.

1.6.5 BRICK-ON-EDGE COPING, PLINTH PROJECTION AND CUT BRICK CORNERS:

The top course of all plinths, parapets, steps and tops of walls below RCC slabs, beams etc. shall be laid with brick-on-edge, unless specified otherwise. Care shall be taken that bricks forming the top corners and ends of walls shall be properly radiated and keyed into position as specified in IS : 2212.

Plinths of all buildings shall be protected by brick on edge paring of minimum width of 750 mm, interspaces filled with cement mortar (1:6).

1.6.6 CURING AND PROTECTION:

Masonry during and after construction shall be kept moist and cured properly as per IS Codes or as directed by the Engineer. The brickwork shall be kept moist for a period of at least 10 days.

1.6.7 SCAFFOLDING:

Double scaffolding having two sets of vertical supports shall be provided except in case of building upto two storeys where single scaffolding may be used if permitted by the Engineer. The supports shall be sound and strong and of steel tubular construction unless otherwise permitted by the Engineer. The
vertical posts shall be tied together with horizontal pieces over which the scaffolding planks shall be fixed. In cases where single scaffolding has been allowed by the Engineer, the inner ends of horizontal scaffolding poles shall rest in a hole provided in the header course only. One header for each hole shall be left out. Such holes, however, shall not be allowed in pillars under one metre in width or immediately near the skew backs of arches. The holes left in masonry work for supporting the scaffolding shall be immediately filled and made good before plastering.

1.6.8 I.S. Code:

All relevant IS codes/CPWD/NBO/International Standards shall be followed. A few of them are mentioned below:

- IS : 2212 - Code of Practice for Brickwork.
- IS : 1077 - Specifications for common burnt clay building bricks.
- IS : 269 - Portland Cement.
- IS : 383 - Sand for construction purpose.

1.7 FINISH TO MASONRY AND CONCRETE:

1.7.1 SCOPE:

This specification covers repairing, finishing, curing, testing, protection, maintenance till handing over of finishing items for masonry and concrete.

Before commencing finishing items the Contractor shall obtain the approval of the Engineer regarding the scheduling of work to minimise damage by other trades. He shall also undertake normal precaution to prevent damage of disfiguration to work of other trades or other installations.

1.7.2 WORKMANSHIP:

1.7.2.1 Preparation of Surface:

All joints in masonry walls shall be raked out to a depth of at least 10 mm with a hooked tool made for the purposes while the mortar is still green. Walls shall be brushed down with stiff wire brush to remove all loose dust from joints and thoroughly washed with water. All laitance shall be removed from concrete to
be plastered.

For all types of flooring, skirting and dado work, the base cement concrete slab or masonry surface shall be roughened by chipping and cleaned of all dirt, grease or loose particles by hard brush and water. The surface shall be thoroughly moist to prevent absorption of water from the base course. Any excess of water shall be mopped up.

At any point, the level of base shall be lower than the theoretical finished floor level by the thickness of floor finish. Any chipping or filling to be done to bring the base to the required level shall be brought to the notice of the Engineer and his approval shall be taken regarding the method and extent of rectification work required.

Prior to commencement of actual finishing work, the approval of the Engineer shall be taken as to the acceptability of the base.

1.7.2.2 Plastering:

1.7.2.2.1 Mortar:

Mortar for plastering shall be as specified in the Schedule of items.

For sand cement plaster, sand and cement in the specified proportion shall be mixed dry on a watertight platform and minimum water added to achieve working consistency.

For lime gauged plaster, lime putty or hydrated lime and sand in the required proportion shall be mixed on a watertight platform with necessary addition of water and thoroughly ground in mortar mill. This mix shall then be transferred to a mechanical mixer to which the required quantity of cement is added and mixed for at least 3 minutes.

No mortar which has stood for more than half an hour shall be used; mortar that shows tendency to become dry before this time, shall have water added to it.

1.7.2.2.2 Application of Plaster:

Plaster, when more than 12 mm thick, shall be applied in two coats - a base coat followed by the finishing coat. Thickness of the base coat shall be sufficient to fill up all unevenness in the surface; no single coat, however, shall exceed 12 mm in thickness. The lower coat shall be thicker than the upper coat. The overall thickness of the coats shall not be less than the minimum thick-
ness shown on the drawings. The undercoat shall be allowed to dry and shrink before applying the second coat of plaster. The undercoat shall be scratched or roughened before it is fully hardened to form a mechanical key. The method of application shall be 'thrown on' rather than 'applied by trowel'.

To ensure even thickness and true surface, patches of plaster about 100 mm to 150 mm square or wooden screed 75 mm wide and of the thickness of the plaster shall be fixed vertically about 2000 mm to 3000 mm apart to act as gauges. The finished wall surface shall be true to plumb and the Contractor shall without any extra cost to the Owner make up any irregularity in the brickwork with plaster. All vertical edges of brick pillars, door jambs etc. shall be chamfered or rounded off as directed by the Engineer. All drips, grooves, mouldings and cornices as shown on drawing or instructed by the Engineer shall be done with special care to maintain true lines, levels and profiles. After the plastering work is completed all debris shall be removed and the areas left clean. Any plastering that is damaged shall be repaired and left in good condition at the completion of the job.

1.7.2.2.3 Finish:

Generally, the standard finish shall be used unless otherwise shown on drawing or directed by the Engineer. Wherever any special treatment to the plastered surface is indicated, the wok shall be done exactly as shown on the drawings, to the entire satisfaction of the Engineer regarding the texture, colour and finish.

a) Standard Finish:

Wherever punning is indicated, the interior plaster shall be finished rough. Otherwise, the interior plaster shall generally be finished to a smooth surface. The exterior surface shall generally be finished with a wooden float.

b) Neat Cement Finish:

Immediately after achieving a true plastered surface with the help of a wooden straight edge the entire area shall be uniformly treated with a paste of neat cement at the rate of 1 Kg per Sq.M. and rubbed smooth with a trowel.

c) Coloured Plaster Finish:

This shall be done in the same way as specified in Clause 2.7.2.2.2 but using coloured cement in place of ordinary cement. When coloured plastering is specified in more than one coat the top coat only shall be made with coloured cement.
Coloured cement shall be either ready mixed material or may be obtained by mixing pigments and cement at site as approved by the Engineer. The pigments to be mixed with cement shall conform to appendix of IS : 2114 latest edition. Samples of colouring material shall be submitted to the Engineer for approval and material procured, shall conform in all respects to the approved samples, which shall remain with the Engineer. All coloured cement and/or pigments shall be stored in an approved manner in order to prevent deteriorations.

d) Pebble-dash finish:

Mortar of required thickness consisting of 1 part cement and 4 parts sand by volume shall be applied in the usual manner as described under plastering clause 2.7.2.2.2. While the mortar is still plastic small pebbles or crushed stone of size generally from 10 mm to 20 mm as approved by the Engineer shall be thrown on the plastered surface. The aggregate shall be lightly tapped into the mortar with a wood float or the flat end of a trowel, in order to ensure satisfactory bond between the dashing and the mortar.

e) Rough-cast Finish:

A wet plastic mix of 3 parts coloured cement, 6 parts sand and 4 parts aggregate by volume (gravel or crushed stone of size from 6 mm to 12 mm as approved by the Engineer) shall be thrown to the wall by means of a plaster’s trowel and left in the rough condition.

f) Scraped Finish:

Ordinary plaster as described under Clause 2.7.2.2.2 after being levelled and allowed to stiffen for a few hours, shall be scrapped with a steel straight edge to remove the surface skin. The pattern shall be as approved by the Engineer.

g) Textured Finish:

Mortar consisting of 1 part cement and 3 parts sand by volume shall be applied in a manner as specified under ‘plastering’ clause 2.7.2.2.2. Ornamental treatment in the form of horizontal or vertical rib texture, fan texture etc. shall be applied by means of suitable tools to the freshly applied plastered surface, as approved by the Engineer.
1.7.2.4 Curing:

All plastered surfaces after laying shall be watered for a minimum period of seven days by an approved method and shall be protected from excessive heat and sunlight by suitable approved means. Moistening shall commence as soon as the plaster has hardened sufficiently and not susceptible to damage. Each individual coat of plaster shall be kept damp continuously for at least two days and then dried thoroughly before applying the next coat.

1.7.2.3 Painting to Masonry:

All joints of brickwork shall be raked out to a depth of 10 mm with a hooked tool made for the purpose while the mortar is still green. The brickwork shall then be brushed down with a stiff wire brush so as to remove all loose dust from the joints and thoroughly washed with water. Mortar consisting of 1 part cement and 3 parts clean, sharp, well graded sand by volume shall be pressed carefully into the joints and finishes with suitable tools to shape as shown on the drawings. Any surplus mortar shall be scrapped off the wall face leaving the surface clean. The painted surface shall be kept wet for at least three days for curing.

1.7.2.4 Plaster with Metal Lath:

The supports, hangers, brackets, cleats etc. shall be as shown on drawings and/or as approved by the Engineer. These shall have a coat of prime paint before and another coat of approved paint after erection. The metal lath shall be expanded metal, with 12 mm x 38 mm mesh, 16 BG thick and 3 mm wide strands. Side laps shall be minimum 12 mm and end laps 25 mm minimum. The plastering shall be minimum 20 mm thick measured from the back of lath and applied in two layers. The mortar for plastering shall consist of 1 part cement, 1/2 part lime and 4 parts sand by volume or 1 part cement and 4 part sand by volume mixed as specified in plastering, clause 1.7.2.2.1. The application, finish etc. shall be as specified under relevant clause above. Where called for in the Schedule of items, a 2 mm plaster or paris punning shall be applied over plaster as a finishing coat to give perfectly smooth and even finish.

1.7.2.5 Lime Punning:

For plastered surface, where an even smooth surface is specified, lime punning with 5 parts of shell-lime properly slaked, strained and aged, mixed with one part clean, washed, sieved, fine sand by volume shall be done. The thickness of lime punning shall be not less than 2 mm and more than 3 mm. The
plastered surface shall be saturated with water before application of the lime punning. The punning shall be applied by skilled workmen and given a smooth and even finish free from undulations, cracks etc. and to the satisfaction of the Engineer.

1.7.2.6 Plaster of Paris Punning:

Plastered surfaces, where specified shall be finished with plaster-of-paris punning. The material shall be from approved manufacturers and approved by the Engineer. The thickness of the punning shall be 2 mm and shall be applied by skilled workmen. The finish shall be smooth, even and free from undulation, cracks etc.

Before bulk work is taken in hand a sample of punning shall be done on roughly 10 Sq.M. area and approval of the Engineer taken. The work shall then be taken in hand as per approved sample.

1.7.2.7 Stone Facing:

Stone Facing where specified shall be done as shown on design drawings and approved working drawings. The stone shall be specified on drawings and/or schedule of items. Sample of stone shall be submitted to the Engineer for approval and then bulk purchase made. The Contractor shall submit three copies of working drawing for the Engineer’s approval before commencing the work.

The thickness of facing stone shall be not less than 25 mm unless otherwise specified on drawings.

The stone slabs shall be cut and finished to sizes as per pattern shown on drawings. They shall be fastened to wall with suitable non-corrodable anchorage as approved by the Engineer. Where mild steel clamps, stays etc. are used for anchorage, they shall be galvanised (weight of zinc coating shall not be less than 700 gms per square metre of surface) to prevent rust stains developing on the finished surface. There shall be at least 12 mm gap between the stone and masonry, which shall be filled up and packed by a mortar of 1 part cement and 3 parts of sand by volume. After the mortar is set and cured for at least four days, the exposed surface shall be neat, of uniform texture and acceptable to the Engineer.

Where painting is specified on drawings it shall be done by mortar as specified on drawings and/or Schedule of items.
1.7.3 ACCEPTANCE CRITERIA:

Finish to masonry and concrete shall fully comply with the drawings, specification, approved samples and instructions of the Engineer with respect to lines, levels, thickness, colour, texture, pattern and any other special criteria as mentioned in the body of the specification or as shown on drawings and successful passing of all quality control tests.

1.7.4 I.S. CODE:

All relevant IS codes/CPWD/NBO/International Standards shall be followed. A few of them are mentioned below:

a) IS - 1661 - Code of practice for cement and cement-lime plaster finish on walls and ceilings.

b) IS - 4101 - Code of practice for external facings and veneers.

1.8 SUPPLYING AND LAYING OF RCC PIPES:

1.8.1 SCOPE:

This specification covers the supply and laying of RCC Hume pipes as may be required. The entire work shall be carried out as per latest editions of Indian Standards IS : 458 and IS : 783.

1.8.2 SUPPLY OF PIPES:

The Contractor shall supply the RCC Hume Pipes of various diameters along with complete fittings required for carrying out the work. RCC Hume pipes should conform to class NP 3 or NP 2 of IS : 458, as may be required and should be in good condition. The Contractor must furnish on being demanded by the Engineer, manufacturer's certificate and/or test.

1.8.3 ALIGNMENT, LEVEL & GRADE:

The work shall be carried out in conformance to the alignment, levels and grades specified in the drawings. The layout and levels should be made by him at his own cost from one reference grid and bench mark given by the Engineer. He shall give all help in instruments, materials and men to the Engineer for checking the detailed layout and levels as and when required. Making of reference layout and level pillars along the pipe line route and maintaining them upto completion of the work shall be the responsibility of the
1.8.4 LAYING OF PIPES:

1.8.4.1 General:

The laying of RCC pipes shall conform to clause 9 of IS: 783.

1.8.4.2 Conditions for laying:

The conditions for laying of pipes to suit the conditions at site and/or as per drawings and instruction of the Engineer shall be as classified below:

1.8.4.2.1 Culvert Condition:

In this condition the pipe is laid under embankment and may project wholly or partly above the original ground surface.

1.8.4.2.2 Trench Condition:

In this condition the pipe is laid in a trench excavated for the purpose. The trench shall be refilled with thoroughly tamped earth after laying and jointing of pipes in approved manner.

1.8.4.2.3 Open Condition:

In this condition the pipe is laid such that it projects wholly or partly above original ground surface, there being no superimposed overburden on the pipe.

1.8.4.3 Bedding & Supports:

1.8.4.3.1 Culvert condition:

In this condition the pipes shall be laid generally on 'First Class Bedding' as per Clause No. 4.3.3 of IS: 783, unless directed otherwise.

1.8.4.3.2 Trench Condition:

In this condition the pipes shall be laid generally on 'First Class Bedding' as per Clause No. 4.2.3 of IS: 783, unless directed otherwise.

1.8.4.3.3 Concrete Cradle Bedding:

If required by the drawing or so instructed by the Engineer, the pipes shall be laid on concrete cradles, conforming to clause no. 4.2.4 of IS: 783 in case of trench condition and conforming to clause no. 4.3.4 of IS: 783 in case of culvert condition.
1.8.4.3.4 Open Condition:

In Open condition the pipe line shall be supported over rigid pedestals constructed at intervals not greater than the length of one individual piece of pipe, as per drawings and instructions of the Engineer. In no case shall the joint between two pipes shall lie at centre of the span between two supports. The pedestals shall be of rubble masonry or brick masonry or plain/reinforced concrete with a properly shaped out top to receive the pipe.

1.8.4.4 Jointing of Pipes:

The clause 10 of IS : 783 shall be applicable for jointing of pipes and every possible care shall be taken. The Contractor shall have to ensure that the joints made are leak proof. Curing of joints shall be done for a period of 10 days. No extra payment shall be made for making and curing of joints.

1.9  TECHNICAL SPECIFICATION FOR PAINTING, WHITE WASHING, POLISHING ETC.:

1.9.1 SCOPE:

This specification covers painting, white washing, polishing etc. of both interior and exterior surfaces of masonry, concrete, plastering, plaster of paris, false ceiling, structural and other miscellaneous steel items, rain water down comer, floor and roof drains, soil, waste and service water pipes and other ferrous as well as non-ferrous metal items as shown on drawings or as directed by the Engineer.

If surface to be finished cannot be put in suitable condition for painting by customary preparatory methods, the Contractor shall notify the Engineer in writing or assume responsibility for and rectify any unsatisfactory finishing that results.

Before commencing painting, the Contractor shall obtain the approval of the engineer in writing regarding the scheduling of work to minimise damage, disfiguration or staining by other trades. He shall also undertake normal precautions to prevent damage, disfiguration or staining to work of other trades or other installations.

1.9.2 INSTALLATION:

1.9.2.1 MATERIAL:

Material shall be highest grade products of well-known approved manufacturer
and shall be delivered to the site in original sealed containers bearing brand name, manufacturer's name and colour shade, with labels intact and seals unbroken. All materials shall be subject to inspection, approval by the Engineer. It is desired that materials of one manufacturer only shall be used as far as possible and paint of one shade be obtained from the same manufacturing batch. All paint shall be subjected to analysis from random samples taken at site from painters bucket, if so desired by the Engineer.

All prime coats shall be compatible to the material of the surface to be finished as well as to the finishing coats to be applied. All unspecified materials such as shellac, turpentine or linseed oil shall be of the highest quality available and shall conform to the latest I.S. Standards. All such materials shall be made by reputable recognised manufacturers and shall be approved by the Engineer.

All colours shall be as per painting schedule and tinting and matching shall be done to the satisfaction of the Engineer. In such cases, where samples are required, they shall be executed in advance with the specified materials for the approval of the Engineer.

1.9.2.1.1 WHITE WASHING :

White washing shall be done from pure shell lime or fat lime or a mixture of both as instructed by the Engineer and shall conform to IS: 712 (latest edition). Samples of lime shall be submitted to the Engineer for approval and lime as per approved sample shall be brought to site in unslaked condition. After slaking, it shall be allowed to remain in a tank of water for two days and then stirred up with a pole, until it attains the consistency of thin cream. 100 gms of gum to 6 litres of white wash water and a little quantity of indigo or synthetic ultramarine blue shall be added to the lime.

1.9.2.1.2 Water - proof Cement Paint :

Water-proof cement paint shall be made from best quality white cement and lime resistant colours with accelerators, waterproofing agents and fungicides. The paint shall conform to IS : 5410.

1.9.2.1.3 Acrylic Emulsion Paint :

Acrylic Emulsion Paint shall be water-based acrylic copolymer emulsion with rutile titanium dioxide and other selected pigments and fungicide. It shall exhibit excellent adhesion to plaster and cement surface and shall resist deterioration by alkali salts. The paint film shall allow the moisture in wall to escape without peeling or blistering. The paint, after it is dried, shall be able to withstand washing with mild soap and water without any deterioration in colour or without showing flaking, blistering or peeling.
1.9.2.1.4 Synthetic enamel paint:

Synthetic enamel paint shall be made from synthetic resins and drying oil with rutile titanium dioxide and other selected pigments to give a smooth, hard, durable and glossy finish to all exterior and interior surfaces. White and pestle shades shall resist yellowing and darkening with ageing. The paint shall conform to IS: 2932 & IS: 2933.

1.9.2.2 STORAGE:

The contractor shall arrange for safe and proper storage of all materials and tools. Paints shall be kept covered at all times and mixing shall be done in suitable containers. All necessary precautions shall be taken by the contractor to prevent fire.

1.9.2.3 Preparation of Surface:

Before starting the work the contractor shall obtain the approval of the Engineer regarding the soundness and readiness of the surface to be painted on.

1.9.2.3.1 Masonry, Concrete and Plastered Surface:

Surface shall be free from all oil, grease, efflorescence, mildew, loose paint or other foreign and loose materials. Masonry cracks shall be cleaned out and patch filled with mortar similar to the original surface and uniformly textured. Where this type of resurfacing may lead to the finishing paint being different in shade from the original surfaces, the resurfaced area shall be treated with minimum one coat of cement primer which should be continued to the surrounding area from a distance of minimum 100 mm.

Surface with mildew or efflorescence shall be treated as below:

a) Mildew

All mildewed surfaces shall be treated with an approved fungicide such as ammoniacal wash consisting of 7 gm of copper carbonate dissolved in 80 ml liqueur ammonia and diluted to 1 litre with water or 2.5 per cent magnesium silicofluoride solution and allowed to dry thoroughly before paint is applied.

b) Efflorescence

All efflorescence shall be removed by scrubbing affected surfaces with a solution of muriatic acid in water (1:6 to 1:8) and washed fully with clear water and allowed to dry thoroughly.
1.9.2.3.2 Metal:
All metal surfaces shall be absolutely clean, dry and free from wax, grease or dried soap films. All steel and iron surfaces in addition shall be free from rust. All galvanised iron surfaces shall be pre-treated with a compatible primer according to the manufacturer's direction. Any abrasion in shop coat shall be touched up with the same quality of paint as the original coat.

1.9.2.4 APPLICATION:

1.9.2.4 General:
The method of application shall be as recommended by the manufacturer. In case of selection of special shades and colour (not available in standard shades) the contractor shall mix different shades and prepare test panels of minimum size 1 metre square as per instruction of the engineer and obtain his approval prior to application of finishing paints.

Proper tools and implements shall be used. Scaffoldings, if used, shall be independent of the surface to be painted to avoid shade differences of the freshly repaired anchor holes.

Painting shall be done by skilled labours in a workmanlike manner. All materials shall be evenly applied, so as to be free of sags, runs, crawls or other defects. All coats shall be of proper consistency. In case of application by brush, no brush marks shall be visible. The brushes shall be clean and in good condition before application of paint.

All priming undercoats for painting shall be applied by brush only and rollers, spray equipments etc., shall not be used.

No work shall be done under conditions that are unsuitable for production of good results. No painting shall be done when plastering is in progress or is drying. Application of paint which seals the surface to moisture shall only be done after the moisture on and below the surface has dried out.

All coats shall be thoroughly dry before being sand papered or before the succeeding coat is applied. Coats of painting as specified are intended to cover surfaces perfectly. In case the surface is not covered properly by applying the specifying number of coats, further coats shall be applied by the Contractor when so directed by the Engineer.

All primers and undercoats shall be tinted to approximate the colour of the finishing coat. Finished coats shall be of exact colour and shade as per approved samples and all finish shall be uniform in colour and texture. All parts of mouldings and ornaments shall be left clean and true to finish.
1.9.2.4.2 **White Washing** :

The surface where white washing is to be applied shall be cleaned of all loose materials and dirt. All holes and irregularities of the surface shall be filled up with lime putty and shall be allowed to dry up before application of the lime solution. One coat of white wash shall consist of one stroke from top downwards, another from bottom upwards over the first stroke and another from left to right before the previous one dries up. Second coat shall be applied after the first coat dries up completely and similarly third coat shall be applied and in case the Engineer feels that one or more coats are required the contractor shall do so without any extra cost to the owner. No brush marks shall show on the finished surfaces. The inner plastered surfaces of walls shall be given 3 or more coats of white washing.

1.9.2.4.3 **Water-proof Cement Paint** :

Surface to be coated with cement paint shall be washed and brushed down. As soon as the moisture has disappeared, the surface shall be given one coat of paint. Care shall be taken so that the paint does not dry out too rapidly. After 4 to 6 hours, the water shall be sprinkled over the surface to assist curing and prevent raking. After the first coat has dried (24 to 48 hours), the second coat shall be applied in similar manner. The finished surface shall be kept moist by occasional sprinkling with water for seven days after painting.

1.9.2.4.4 **Acrylic Emulsion Paint** :

Lime gauged cement plastered surface shall not be painted for at least one month after plastering. A sample patch shall be painted to check alkali reaction if so desired by the Engineer. Painting shall be strictly as per manufacturer's specification.

1.9.2.4.5 **Synthetic Enamel paint** :

Synthetic Enamel paint shall be applied on properly primered surface. Subsequent coat shall not be applied till the previous coat is dry. The previous coat shall be lightly sand papered for better adhesion of subsequent coat.

1.9.2.5 **Cleaning up** :

The contractor shall, upon completion of painting, remove all marks and make good surfaces, where paint has been spilled, splashed or splattered, including equipments, fixtures, glass, furniture fittings etc. to the satisfaction of the Engineer.

1.9.3 **Acceptance Criteria** :

a) All painted surfaces shall be uniform and pleasant in appearance.

b) The colour, texture etc. shall match exactly as per the approved samples.

c) All stains, splashes and splatters of paints shall be removed from surrounding surfaces.

d) The work shall pass all relevant quality control tests.
1.9.4 I.S. Codes:

All relevant latest IS codes/CPWD/NBO/International Standards shall be followed. A few of them are mentioned below:

IS:2932 : Specification for enamel, synthetic exterior, type - I
IS:2933 : Specification for enamel, synthetic exterior, type - II
IS:5410 : Specification for cement paint colour as required.

1.10 TECHNICAL SPECIFICATION FOR DRAINAGE AND SANITARY FIXTURES:

1.10.1 SCOPE:

1.10.1.1 This section covers the layout and construction of drains for foul water, surface water, sub soil water (wherever required) and sewage together with all fittings and fixtures and inclusive of ancillary works related to drainage and sanitary works for the whole plant.

1.10.2 INSTALLATION:

1.10.2.1 General:

All pipe lines, locations of fittings and fixtures etc. shall be as per drawings or as directed by the Engineer. Correctness of lines, plumb, orientation, symmetry and levels shall be strictly ensured. All items shall be fully secured against movement in any direction and so located as to allow easy maintenance where desired by the Engineer. Suitable workers to be provided for underground and concealed pipelines and other items.

All pipelines and fittings, fixtures shall be installed leakproof. When the work under scope of this specification connect with others, the connection shall be such as to prevent any splashing or spilling or emission of foul odour and gases.

1.10.2.1 Rainwater Down Comers:

Rainwater down comers shall be standard cast iron pipes. Rainwater down comers shall run along and be secured to walls, columns etc. Where desired by the Engineer these may have to be installed in cut in the structure. All pipes shall be well secured and supported by adequately strong brackets. The brackets may be wrought iron clevis type, split ring type or perforated strap iron type as approved by the Engineer. For vertical runs each pipe shall hang freely on its bracket fixed just below the socket. Suitable space blocks shall be provided against the vertical surface to which the pipe is fixed.
All bends and junctions shall be supplied with watertight cleanouts. Roof and floor drains and yard gullies shall be installed if required, but by cutting into the structure and grouted with M-15 cement concrete. All gutters shall be provided with removable gratings.

All horizontal pipes shall have a minimum fall of 1 in 100.

1.2.10.2.2 Gutters:

The gutters shall be made of GI or A.C. All gutters shall be supplied by reputable specialised firms. Each section shall be sufficiently rigid, edges and corners straight and the slopes perfectly uniform. The G.I. gutters shall have the edges strengthened by suitable means.

Unless noted otherwise the gutters shall have minimum fall of 1 in 120. Adequate number of strong supports shall be provided so that there is no deflection even when the gutter is full. Each joint must have a support. Unless otherwise specified the supports shall be fabricated M.S brackets. All junctions shall be thoroughly watertight. The joints may be made by riveting, bolting or soldering. All joints between successive lengths of gutters shall have an overlap of at least 5 cm. The drop in the overlap shall always be in the directions of the fall of the gutter. Ends of gutters shall be closed watertight. Junction with rainwater down comers shall be made fully watertight and secured.

1.10.2.3 Soil & Drainage Pipes (within building):

1.10.2.3.1 Gradients:

If not specified the minimum gradients of soil and drainage pipe lines shall be as follows:

- 100 mm nominal dia : 1 in 35
- 150 mm nominal dia : 1 in 65
- 230 mm nominal dia : 1 in 120
- 300 mm nominal dia : 1 in 200

1.10.2.3.2 Relation with Water Supply Pipe Lines:

Under no circumstances unless specifically cleared by the Engineer, any drainage and soil pipes shall be allowed to come close to water supply pipe lines.

1.10.2.3.3 Laying:

Each separate pipe shall be individually set for line and for level. Where
lengths of sewer or drain pipes are laid in trench, properly painted sight-rails shall be fixed across the trench at a height, equal to length of the boning rod to be used, above the required invert level of the drain or sewer at the point where the sight is fixed. More sight rails shall be required at manholes, change of gradient and intermediate positions if the distance for sighting is too far, which shall not be more than 50 ft apart. The excavation shall be boned in at least once in every 6 ft. the foot of the boning rod shall be set on a block of wood of the exact thickness of the wall of the pipe. Each pipe shall be separately and accurately boned between sight rails.

1.10.2.3.4 Support and Protection to Pipelines :

All pipes shall be laid with sockets leading uphill. Preferably the pipe shall rest on solid and even foundations for the full length of the barrel. However the pipe manufacturer's instruction as approved by the Engineer shall be followed in the matter of support and jointing.

For others, to achieve full and continuous support, concrete for bedding and packing is the best. Where pipes are not bedded on concrete, the floor shall be left slightly high and carefully bottomed up as pipe-laying proceeds so that the pipe barrels rest on undisturbed ground. If anywhere the excavation has been carried too low, the packing shall be done in concrete. Where laid on rock or very hard ground that cannot be easily excavated to a smooth surface, the pipes shall be laid on a cradle of fine concrete floor or floor of gravel and crushed stone bed only as desired by the Engineer so as to install even on bearing. PVC or similar pipes shall be laid directly on stable soil and packed with selected soil.

The minimum support and protection for glazed stone ware pipes shall be as follows :

a) When cover is less than 1 metre below ground level and where pipes are unavoidably exposed above ground surface, the pipes shall be completely encased or surrounded with concrete.

b) Where the pipes are laid on a soft soil with the maximum water table lying at the invert of the pipe, the pipe sewer shall be bedded on concrete.

c) Where the pipes have to be laid on a soft soil with the maximum water table rising above the invert of the pipe, but below the top of the barrel, the pipe sewer shall be haunched.

d) Where the maximum water table is likely to rise above the top of the barrel or wherever the pipe is laid on soft soil, the pipe sewers shall be completely encased or surrounded with concrete.

Vitrified clay pipes shall be laid on a bed on 150 mm thick cement concrete (1:3:6 nominal mix by volume).
Cast iron pipes and concrete pipes may be supported on suitable concrete or brick support, where specified. The supports shall be unyielding and strong enough. At least one support shall be located close to each joint. Spacing of intermediate supports shall be as directed by the Engineer. Pipes shall be secured to the supports by approved means.

Anchoring of pipes where necessary shall be achieved by suitable concrete encasing designed for the specified thrust.

1.10.2.3.5 Entry into Structures:

For entry of the pipe lines into the building suitable conduits under the structure or sleeves shall be used. The conduits and sleeves shall be such as to allow easy repairs and replacement of the pipes. When openings or chases are required to be made in the structure for entry of pipe lines, locations and sizes shall be marked by the Engineer. After laying of the pipelines the openings and chases shall be mended.

1.10.2.3.6 Ducts:

Where soil, waste and ventilating pipes are accommodated in ducts, access to cleaning eyes shall be provided. Connection to drain shall be through a gully with sealed cover to guard against ingress of sewer gas, vermin or backflow.

1.10.2.3.7 Traps & Ventilating Pipes:

Pipes for carrying off the waste from water closets and waste water and overflow water from baths, wash basins, sinks to drains shall be trapped immediately beneath such fixtures. Traps shall have minimum water seal of 50 mm and shall be ventilated wherever such ventilation is necessary to maintain water seal of the trap.

Ventilating pipes shall be carried up vertically from the drain to a height of at least 600 mm above the outer covering of the roof of the building or as shown on drawings. All vertical ventilating, anti-syphonage and similar pipe shall be covered on top with a cowl. The cowl shall be made of C.I unless desired otherwise by the Engineer.

1.10.2.3.8 Manholes & Inspection Chambers:

The maximum distance between manholes shall be 30 metre unless specially permitted otherwise. In addition, at every change of alignment, gradient or diameter there shall be a manhole or inspection chamber and the spacing shall not exceed 6 metre unless desired otherwise. Manhole shall be constructed so
as to be watertight under test. The benching at the sides shall be carried out in such a manner as to provide no lodgement for any splashing in case of accidental flushing of the chamber. The channel or drain at the bottom of chamber shall be plastered with 1:2 cement-sand mortar and finished smooth to the grade. The channels and drains shall be shaped and laid to provide smooth flow. Connection to existing sewer lines shall be through a manhole. Manholes shall be provided with standard covers, usually C.I. or as desired by the Engineer. The covers, shall be close fitting so as to prevent gases coming out.

1.10.2.3.9 Cutting of Pipes:
Manufacturer’s instruction shall be followed for cutting of pipes where necessary. Suitable and approved tools shall be used for the cutting so as to leave clean and square surface to the axis of the pipe.

1.10.2.3.10 Jointing:
Jointing of laid pipes shall be so planned as to avoid completely any movement or strain to the joints already made. If any joint is suspected to be damaged it shall be opened out and redone.

All joints between pipes, pipes and fittings and manholes shall be gastight when above ground and watertight when underground. Method of jointing shall be as per instruction of the pipe and fittings’ manufacturer and as approved by the Engineer. However, in the absence of any instruction available from the manufacturer the methods as detailed here under shall be used.

a) Cast Iron Pipes:
Socket and spigot pipes shall be joined by cast lead joints. The spigot shall be centred in the socket of the next pipe by tightly caulking in sufficient turns of tarred gasket or hemp yarn to have unfilled half the depth of socket. When the gasket or hemp yarn has been caulked tightly a jointing ring shall be placed round the barrel and tight against the face of the socket to prevent airlock. Molten lead shall then be poured in to fill the remainder of the socket and caulked with suitable tools right round the joint to make up for shrinkage of the molten metal on cooling and shall be finished 3 mm behind the socket face.

Joints in cast iron pipes with special jointing arrangements like ‘Tyton’ joints etc. shall follow the instructions of the manufacturers.

In special cases if flanged joints are accepted by the Engineer the joints shall be made leak-proof by inserting approved type of rubber or other gaskets. The bolts shall be secured in stages to avoid uneven strain.

b) Concrete Pipes:
Care shall be taken to place the collar centrally over the joints.
c) Glazed Stoneware Pipes:

Tarred gasket or hemp yarn soaked in thick cement slurry shall first be placed round the spigot of each pipe and the spigot shall then be placed into the socket of the pipe previously laid. The pipe shall then be adjusted and fixed in the correct position and the gasket caulked tightly so as not to fill more than 1/4 of the total depth of the socket. The remainder of the socket shall be filled with a stiff mixture of cement mortar of 1:1 proportion. When the socket is filled, a fillet shall be formed round the joint with a trowel, forming an angle of 45° with the barrel of the pipe. The newly made joints shall be protected, until set, from sun and rain and shall be covered with damp sacking or other suitable materials.

d) Vitrified Clay Pipes:

These shall be made from refractory clay mixed with crushed pottery and stone and burnt at a high temperature. These shall be hard, compact and glazed to make them acid resistant and impervious and shall be obtained from approved manufacturer.

Being very brittle special care shall be taken in handling these pipes. The pipes shall not be jointed until the earth has been partly refilled over the portion of the pipe between the joint holes. Before laying the second pipe, the socket of the first pipe laid shall be thinly painted all around on the inside with cement slurry (1 part of cement & 2 parts of clean, sharp sand). A ring of rope yarn (closely twisted hemp or jute) dipped in neat cement paste or tar or bitumen shall be inserted in the socket of the pipe and driven home with caulking tools. The rope shall fully encircle the spigot with a slight overlap and shall not occupy more than one-fourth of the total depth of the socket. Where the spigot end of the pipe is made for receiving the gasket, it shall be wrapped round with two or three turns of tarred spun yarn, as near the end as possible, before inserting into the socket. The joint shall then be completely filled with cement mortar (1:1) which shall have very little water and leveled to form a splayed fillet at an angle of 45 degrees with the outside pipe. Special care shall be taken so that any excess mortar etc. left inside the pipe joint is neatly cleaned off immediately after the each joint is made. A semi-circular wooden scrapper or a rubber disc can be used to which a long handle is fixed.

e) Lead Pipes:

The joints in lead pipes shall be made as wiped solder joint. The minimum and maximum length of the wiped solder joints shall be 8 cm and 9 cm respectively. The solders shall generally consist of two parts of lead and one part of tin.
f) Polythene Pipes:
The joints shall be thermo-welded or bolted as per manufacturer's instruction.

g) Jointing Cast Iron Pipes with Stoneware Pipes:
Where any cast iron soil pipe, waste pipe, ventilation pipe or trap is connected with a stoneware or semi-vitrified waste pipe of drain communicating with a sewer, the beaded spigot end of such cast iron soil pipe, waste or ventilating or trap shall be inserted into a socket of such stoneware pipe or drain and the joint made with mortar consisting of one part of cement and one part of clean, sharp sand after placing a tarred gasket or hemp yarn soaked in neat cement slurry round the joint and inserted in it by means of a caulking tool.

h) Jointing Stoneware with Cast Iron Pipes:
Where any water closet pan or earthenware trap connected to such a pan is to be jointed with a cast iron soil pipe, the joint between the stoneware spigot and the cast iron socket shall always be of a flexible nature, such joint shall be made with a mixture of bitumen and chopped asbestos fibre.

1.10.2.4 Trenches and other excavations:
Width of the trench at the bottom shall be such as to provide 200 mm clear-ance on either side of the pipe for facility of laying and jointing.

Excavated material shall be stacked sufficiently away from the edge of the trench and the side of the soil bank shall not be allowed to become such as to endanger the stability of the excavation. Spoil may be carted away and used for filling the trench behind the work.

Turf, top soil or other surface material shall be set aside, turf being carefully rolled and stacked for use in reinstatement.

All excavations shall be properly timbered, where necessary.

Efficient arrangements for dewatering during excavation and keeping it dry till backfilling done shall be made to the satisfaction of the Engineer. Sumps for the dewatering shall be located clear of the pipe layout.

Where the excavation proceeds through roads necessary permissions shall be secured by the contractor from the appropriate authorities.

Special care shall be taken not to damage underground services, cables etc. These when exposed shall be kept adequately supported till the trench is backfilled.
The back filling shall be done only after the pipeline has been tested & approved by the Engineer. Special care shall be taken to pack under and side of the pipe hand packed thoroughly with selected material. If the pipeline is being laid in black cotton soil, it shall be ensured that at least 300 mm of sand bed is provided for the pipeline in addition to backfilling the sides at least 200 mm on sides and topping with minimum 300 mm of sand cushion. Consolidating shall be done in 150 mm layers. The surface water shall be prevented from getting into the filled up trench. Traffic shall not be inconvenienced by heaping up unduly the backfilling material to compensate future settlement. All future settlements shall be made good regularly to minimise inconvenience of traffic where applicable.

1.10.2.5 Fixtures:

The tenderer shall mention in his bid the type and manufacture of the fixtures he intends to use enclosing manufacturer's current catalogues. In the absence of any such agreement the Engineer shall be at liberty to choose any type and manufacture.

All fixtures and fittings shall be of approved quality and type manufactures by well-known manufacturers. All items brought to the site must bear identification marks of the type and manufacturer. Procurements shall be made well in advance and got inspected and approved immediately by the Engineer. All fixtures shall be adequately protected covering and plugging till handed over.

All fittings, gratings, fasteners, unless specified otherwise, shall be chromium plated. The connecting lead pipes and bends shall weigh at least 3 Kg per 25 mm dia per metre length. Where PVC or similar pipes are allowed the contractor shall produce the test reports and convince the Engineer about their durability. Unless specified in the contract the fixture shall be as specified hereinafter.

1.10.2.5.1 Water Closet:

a) Raised Type

It shall include glazed stoneware basin with siphon, open front solid plastic seat, plastic cover, low level glazed stoneware flushing cistern with valveless fittings, supply connections and necessary fittings. All fittings shall be chromium plated. Colour of basin, cistern, seat and cover shall be as desired by the Engineer.

b) Squatting Type

It shall include glazed stoneware pan with foot rests and high level cast iron flushing cistern with valveless fittings supply connections and necessary fittings. All fittings shall be chromium plated. The foot rests shall be made of
white glazed stoneware with chequered surface. The flushing cistern shall be painted as desired by the Engineer.

1.10.2.5.2 Urinals:
It shall consist of wall type glazed stoneware urinals, cast iron automatic flushing cistern complete with supply connections, flush pipe, lead pipes, gratings, traps and all other necessary fittings. Automatic flushing shall be approximately once every five minutes. For a number of urinals located together may be served by one cistern of adequate capacity. All fittings shall be chromium plated.

1.10.2.5.3 Wash Basins:
It shall be made of glazed stoneware. The basin shall be flat back, wall hung by painted cast iron brackets and complete with pattern with hot and cold brass faucets with nylon washers, chain waste, waste washers, lead waste pipes with traps, perforated waste complete with necessary fittings. All fittings including faucets shall be chromium plated.

1.10.2.5.4 Sink:
It shall be made of glazed stone ware. It shall be wall hung by painted cast iron brackets and complete with one brass faucets with nylon washers, chain waste, waste washers, lead waste pipes with traps perforated waste with necessary fittings. All fittings including faucets shall be chromium plated.

1.10.2.5.5 Bathroom Mirror:
It shall be made of the best quality 6 mm thick indigenous glass and produced by a reputed mirror manufacturer. It shall be wall mounted with adjustable revolving brackets. The brackets, screws and other fittings shall be chromium plated.

1.10.2.5.6 Glass Shelves:
Glass shelves shall consist of 6 mm thick clear glass with guard rails and shall be wall mounted with brackets. All brackets, guard rails and screws shall be chromium plated.

1.10.2.5.7 Towel Rail:
Towel rails shall be 20 mm dia chromium plated M.S pipes wall mounted with chromium plated screws.
1.10.2.5.8 Liquid Soap Dispenser:

It shall be round and easily revolving with removable threaded nozzle. The body, bracket for wall mounting and screws shall be chromium plated.

1.10.2.5.9 Toilet Roll Holder:

It shall be made of strong members with suitable cover cum cutter. The whole item including wall mounting screws shall be chromium plated.

1.10.2.5.10 Installation:

All plumbing fittings and fixtures shall be installed in most workmanlike manner by skilled workers. These shall be perfect in level, plumb, plane, location and symmetry. All items shall be securely anchored to walls and floors. All cuttings in walls and floors shall be made good by the contractor.

1.10.2.6 Septic Tank & Effluent Disposal:

1.10.2.6.1 Septic Tank:

Septic tank shall consist of the tank itself with inlet and outlets there from complete with all necessary earthwork and backfilling. The details of septic tank shall be as shown on drawings. This item shall also include ventilating pipe of at least 100 mm dia whose top shall be provided with a suitable mosquito proof wire mesh and cowl. Ventilating pipe shall extend to a height of about 2 metre when the septic tank is at least 15 metre away from the nearest building and to a height of 2 metre above the top of building when it is located closer than 13 metre. Ventilating pipes can be connected to the normal soil ventilating system of the building where allowed.

1.10.2.6.2 Effluent Disposal:

The effluent from the septic tank shall be disposed by allowing it into the open channel or a body of water if the concerned authority approves or into the soakpit for absorption by soil or shall be allowed to be absorbed by soil through open jointed S.W. pipes laid in a trench filled with broken bricks.

1.10.2.6.3 Soak Pit:

The soakpit shall be complete as shown on drawing. In absence of a detailed drawing it shall consist of a 900 mm dia pit 1000 mm in depth below the invert level of the inlet pipe. The pit shall be lined with stone, brick concrete blocks set in cement mortar (1:6) and filled with brick bats. Inlet pipe shall be taken down to a depth of 900 mm from the top as an automatic measure.

1.10.2.6.4 Open Jointed S.W. Pipe:

Minimum dia of the S.W. pipes shall be 200 mm nominal. The trench for laying the pipes shall be minimum 600x600 mm sizes. The joints of the pipes shall be left unsealed.
1.10.2.6.5 Commissioning Of Septic Tank

After the septic tank is proved water tight and the sewage system is checked the tank shall be filled with water to its outlet level before the sewage is let into the tank. It shall be seeded with well digested sludge obtained from septic tank or sludge digestion tank. In the absence of digested sludge a small quantity of decaying organic matter such as digested cow-dung may be introduced.

1.10.3 Testing and Acceptance

1.10.3.1 Inspection before installation

All pipes, fittings and fixtures shall be inspected, before delivery at the site to see whether they conform to accepted standard. The pipes shall again be inspected on site before laying by sounding to disclose cracks. All defective items shall be clearly marked and forthwith removed from the site.

1.10.3.2 Testing of Pipelines

Comprehensive tests of all pipe lines shall be made by simulating conditions of use. The method of actual tests shall be decided by the Engineer. All test data shall be recorded and submitted to the Engineer for review and instruction. The Engineer's discretion regarding tolerance shall be final.

General guidance for the tests are given below:

a) Smoke Test

All soil pipes, waste pipes and vent pipes and all other pipes when above ground shall be approved gastight by a smoke test conducted under a pressure of 25 mm of water and maintained for 15 minutes after all trap seals have been filled with water. The smoke is produced by burning oily waste or tar paper or similar material in the combustion chamber of a smoke machine. Chemical smokes are not satisfactory.

b) Water Test

For pipes other than Cast iron:

Glazed ware and concrete pipes shall be subjected to a test pressure of at least 1.5 m head of water at the highest point of the section under test. The tolerance figure of two litres per centimetre of diameter per kilometre may be allowed during a period of 10 (Ten) minutes. The test shall be carried out by suitably plugging the low end of the drain and the ends of connections, if any, and filling the system with water. A knuckle bend shall be temporarily jointed in at the top end and a sufficient length of the vertical pipe jointed to it so as to provide the required test head of the top end may be plugged with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitably for observation.
Subsidence of test water may be due to one or more of the following causes:

i) Absorption by pipes and joints.

ii) Sweating of pipes or joints.

c) Leakage at joints or from defective pipes.

d) Trapped air.

Allowance shall be made for by addition of water until absorption has ceased and after which the proper test should commence. Any leakage and the defective part of the work shall be cut out and made good.

For Cast Iron pipes:

Cast iron sewers and drains shall be tested as for glazed ware and concrete pipes. The drain plug shall be suitably strutted to prevent their being forced out of the pipe during the test.

e) For Straightness:

i) By inserting at the high end of the sewer or drain a smooth ball of a diameter 13 mm less than the pipe bore. In the absence of obstruction, such as yarn or mortar projecting through the joints, the ball will roll down the invert of the pipe and emerge at the lower end and

ii) By means of mirror at one end of the line and lamp at the other. If the pipe is straight, the full circle of light may be observed. The mirror will also indicate obstruction in the barrel if the pipe line is not straight.

1.10.3.3 Testing Septic Tank:

The septic tank shall be tested for water tightness. It shall be filled up with water and allowed to stand for 24 hours. Then, it shall be topped up and allowed to stand against for 24 hours and loss of level recorded. The fall shall not be more than 15 mm.
1.10.3.4 Fixtures etc. :

All fixtures and fittings shall be connected by watertight joints. No dripping shall be accepted.

1.10.4 I.S. Codes :

All relevant IS codes/CPWD/NBO/International Standards shall be followed. A few of them are mentioned below:

<table>
<thead>
<tr>
<th>IS :</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1172</td>
<td>Code of basic requirements for water supply drainage &amp; sanitation. IS : 1200(Pt. xvi) : Laying of water and sewer lines including appurtenant items.</td>
</tr>
<tr>
<td>1239(Pt.I&amp;II)</td>
<td>Mild steel tubes and mild steel tubulars and other wrought steel pipe fittings</td>
</tr>
<tr>
<td>1536</td>
<td>Centrifugally cast (Spun) iron pressure pipes for water gas &amp; sewage.</td>
</tr>
<tr>
<td>1537</td>
<td>Vertically cast iron pressure pipes for water, gas &amp; sewage.</td>
</tr>
<tr>
<td>3486</td>
<td>Cast iron spigot and socket drain pipes.</td>
</tr>
<tr>
<td>3589</td>
<td>Electrically welded steel pipes for water, gas &amp; sewage (200 mm to 2000 mm nominal dia).</td>
</tr>
<tr>
<td>1742</td>
<td>Code of practice for building drainage.</td>
</tr>
<tr>
<td>5329</td>
<td>Code of practice for sanitary pipe work above ground for buildings.</td>
</tr>
<tr>
<td>2470</td>
<td>Code of practice for design &amp; construction of septic tank for small and large (Part I &amp; II) installations.</td>
</tr>
<tr>
<td>3076</td>
<td>Low density polyethylene pipes for potable water supplies.</td>
</tr>
<tr>
<td>4984</td>
<td>High density polyethylene pipes for water supplies.</td>
</tr>
<tr>
<td>1537</td>
<td>Vertically cast iron pressure pipes for water, gas &amp; sewage.</td>
</tr>
<tr>
<td>1538</td>
<td>Cast iron fittings for pressure pipes for water, gas &amp; sewage.</td>
</tr>
<tr>
<td>3989</td>
<td>Centrifugally cast (spun) iron spigot &amp; socket soil waste and ventilation pipes, fittings and accessories.</td>
</tr>
</tbody>
</table>
1.11 TECHNICAL SPECIFICATION FOR SHEETING WORK IN ROOF & SIDING:

1.11.1 SCOPE:

This specification covers the erection of CGI sheet and polysteel colour coated corrugated sheet covering to roof and side walls at various elevations and the fabrication and/or installation of CGI or polysteel colour coated corrugated sheet gutters, flashing etc. as shown on drawings and schedule of items/scope of work, as applicable. The guidelines, as specified below, are intended to provide general information and guidance in various aspects of handling, storage, installation and fastening etc. General Engineering standards, codes of practice, statutory requirements and applicable BIS or other relevant
standards shall however be complied with.

### 1.11.2 INSTALLATION:

The CGI sheets shall be Class-I galvanised conforming to IS/CPWD/NBO specifications. The polysteel colour coated corrugated sheets shall be conforming to relevant IS specifications and of approved brand/ manufacture. Polysteel is premium quality Cold Rolled Steel Sheet coated with zinc in a Hot dip Galvanising Line and subsequently given multiple layers of organic coatings in a continuous coil-coating line. Polysteel is a composite material which incorporates multilayer coating system comprising zinc, pre-treatment, Epoxy primer, top coat, back coat and guard film conforming to IS : 1246 - 95 and other international standards. Polysteel Building Sheets shall be fixed with Polycoated J-hooks, self tapping or self drilling screws. Accessories such as Ridges, Flashing etc. can be fabricated on site or can be supplied ready-to-use depending upon the requirements. The shade shall be as approved by the Employer. The thickness for the roof and side sheeting shall be 0.80 mm and 0.65 mm respectively.

#### 1.11.2.1 Handling & Storage of Materials:

All materials shall be stored by the contractor in proper way to prevent any damage. If issued at site by the owner, the contractor shall, at the time of issue, satisfy himself about the condition of issued sheets, gutters etc. and no complaints shall be entertained later. The contractor shall ensure to avoid damage to sheets during handling, storage and installation. The unloading, storage and handling shall be done as per instructions of the manufacturer and/or Employer.

#### 1.11.2.2 Workmanship:

Workmanship shall be according to best construction practices to give a water tight finish to the satisfaction of the Engineer. Fixing of gutters and down pipes shall be according to IS : 2527.

#### 1.11.2.2.1 CGI Sheeting:

Side laps shall be 2 corrugations for roof and one corrugation for side sheeting. End laps shall be minimum 150 mm for roof and 100 mm for side sheeting. In ridges and hips where plain sheets are used, the end laps shall be minimum 100 mm. Holes in CGI sheets shall preferably be made on the ground, the sheets should be placed on trestles and holes punched in the ridge of the corrugation from the outsides inward for obtaining proper seating of limpet washers. Sheets shall be secured to sheet framing by 8 mm dia galvanised iron hooks of J bolts and maximum 305 mm apart. The length of the hook of J bolts shall be to suit the sections of the bearer. Sheet shall also be bolted at the ends at every third corrugation with 6 mm dia galvanised iron seam bolts and
GI flat washers and bituminous washers.

1.11.2.2 Fibre Glass Reinforced Plastic Sheeting:

These shall be of thickness and profile as mentioned in the schedule of items. Light transmittance shall be about 60 to 70%. The installation should be such that it fits with the aluminium/ CGI/ Polysteel coloured (as applicable) sheet corrugations and is completely watertight and is able to withstand the designed wind pressure. The end and side laps and fixing device shall be same as used in general sheeting. Where used in lieu of glass, the fixing shall be by means of timber or metal glazing beads as mentioned in schedule of items or elsewhere.

1.11.2.2.3 Poly-steel colour coated corrugated sheets:

Before start of sheeting work, it shall be ensured that purling, girt and structure are in true plane, correctly placed and properly fixed and unpainted structural steel does not come in contact with poly-steel. Sheet laying sequence shall take care of the prevailing wind direction and side laps shall face away from prevailing weather. Extreme care shall be taken to position the first sheet to ensure it lies square and straight in relation to the wall or barge end. Roof should be marked out so that when last sheet is fixed, the distance between the last sheet and the barge board is the same as the first sheet. Laying of each complete row of sheets shall start from eaves towards apex before starting the next row. Sequence of fastening shall be to ensure that end laps are held in position and are fastened in between and thereafter the side lap fasteners are fixed followed by stitch fasteners. Templates shall be used to ensure correct width while laying to avoid creep due to stop ending or unequal pitching. It shall be ensured that only workers wearing soft soled (unribbed) shoes can walk on the roof sheets. In all cases workers should walk on an area close to the supporting structural members or on cat-walk ladders / roof boards. Proper scaffolding/false support should be used for side cladding. In sheets at apex, lean and Periphery need wind ties, Aluminium flat strips or rectangular tubing, as approved by the Employer, shall be used in continuous length fastened every 300 mm. Fasteners shall be same primary fasteners as those used for sheets fixing. The members shall be painted to match the colour.

Side laps shall be secured through the side lap corrugations with self drilling/tapping screws, rivets or seam bolts complete with sealing gasket and washer. XLPE adhesive tapes shall be used for sealing of end laps/longitudinal laps.

All eaves sheets shall be supported as near to the end as possible. Overhang of more than 500 mm shall not be allowed. Roof openings, wherever required, shall be framed openings. Plain sheet flashing to cover the surrounding sheeting upto 200 mm shall be installed properly fastened and sealed.
Holes shall be drilled, not punched. Surplus/unused holes shall be sealed off. In case of self drilling screws where the thickness of steel exceeds fastener manufacturers recommendation, pilot holes shall be drilled a size smaller. Die-cut, profile contoured, closed cell XLPE/PE foam fillers shall be used for closing the voids between capping/flashings and profiles at the ridge and eaves.

Overlaps shall be as below:
- Longitudinal laps 150 - 250 mm depending upon degree of slope for roof & 100 - 150 mm for walls.
- Flashing & trims 50 - 75 mm.

Fasteners shall be corrosion resistant, leak proof and non-staining, non-reactive and be robust enough to remain undamaged while being installed. Damaged, improperly fixed fasteners shall be removed and fresh fasteners be fixed properly. All fasteners for roofing and side cladding shall be capable of resisting the pressures/loads specified as per relevant BIS standards, specifications and codes of practice. Care shall be taken not to overdrive or over-fasten to prevent breakage, pounding, damage to sealing or sheeting.

1.11.3 Acceptance Criteria:

The installations shall present a neat appearance and shall be checked for water tightness. The following shall be checked:

- Side and end laps.
- Absence of cracks, holes or damages in sheets.
- Spacing of bolts.
- Provision of double washer (GI & asbestos or bituminous washers).
- Proper installation of flashing.
- Successful passing of all necessary relevant quality control tests.

1.11.4 I.S. Codes:

All relevant IS codes/CPWD/NBO/International Standards shall be followed. A few of them are mentioned below:

<table>
<thead>
<tr>
<th>IS</th>
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<tbody>
<tr>
<td>3007</td>
<td>Code of practice for laying of asbestos cement sheets.</td>
</tr>
<tr>
<td>2527</td>
<td>Code of practice for fixing rain water gutters and down pipes for roof drainage.</td>
</tr>
<tr>
<td>277</td>
<td>Specification for GI sheets (Plain and Corrugated).</td>
</tr>
<tr>
<td>730</td>
<td>Specification for fasteners for corrugated sheet roofing.</td>
</tr>
</tbody>
</table>
1.11A TECHNICAL SPECIFICATION FOR SHEETING WORK IN ROOF & SIDING:

1.11A.1 SCOPE:

This specification covers the erection of asbestos and CGI sheet covering to roof and side walls at various elevations and the fabrication and/or installation of asbestos of CGI gutters, flashings etc. as shown on drawings and schedule of items.

1.11A.2 INSTALLATION:

The CGI sheets shall be Class-I galvanised conforming to IS/CPWD/NBO specifications. The thickness for the roof and side sheeting shall be 22 and 24 swg respectively.

1.11A.2.1 Storage of Materials:

All materials shall be stored by the contractor in proper way to prevent any damage. If issued at site by the owner, the contractor shall at the time of issue, satisfy himself about the condition of issued sheets, gutters etc. and no complaints shall be entertained later.

1.11A.2.2 Workmanship:

Workmanship shall be according to best construction practice to give a water tight finish to the satisfaction of the Engineer. Fixing of gutters and down pipes shall be according to IS : 2527.

1.11A.2.2.1 CGI Sheeting:

Side laps shall be 2 corrugations for roof and one corrugation for side sheeting. End laps shall be minimum 150 mm for roof and 100 mm for side sheeting. In ridges and hips where plain sheets are used, the end laps shall be minimum 100 mm. Holes in CGI sheets shall preferably be made on the ground, the sheets should be placed on trestles and holes punched in the ridge of the corrugation from the outsides inward for obtaining proper seating of limpet washers. Sheets shall be secured to sheet framing by 8 mm dia galvanised iron hooks of J bolts and maximum 305 mm apart. The length of the hook of J bolts shall be to suit the sections of the bearer. Sheet shall also be bolted at the ends at every third corrugation with 6 mm dia galvanised iron seam bolts and GI flat washers and bituminous washers.

1.11A.2.2.2 Asbestos Sheeting:

Asbestos sheets of profiles, as stated in the schedule of items, shall be fixed with minimum 150 mm end lap and side laps as per manufacturer's specification. Hook bolts or J bolts shall be 8 mm dia. At 305 mm centres. 6 mm dia galvanised iron seam bolt and nut with GI flat washers and bitumen washers shall be used for stitching ridge capping, corner pieces, ventilators, north light curves.
1.11A.2.2.3 Fibre Glass Reinforced Plastic Sheeting:

These shall be of thickness and profile as mentioned in the schedule of items. Colour and light transmittance shall be as mentioned in drawings and/or schedules. Where used in conjunction with CGI or asbestos sheeting, the end and side laps and fixing device shall be same as used for general sheeting. Where used in lieu of glass, the fixing shall be by means of timber or metal glazing beads as mentioned in schedule of items. In all cases, the installation shall be completely watertight and able to withstand the designed wind-pressure as mentioned in schedule.

1.11A.3 Acceptance Criteria:

The installations shall present a neat appearance and shall be checked for watertightness. The following shall be checked:

a) Side and end laps.
b) Absence of cracks, holes or damages in sheets.
c) Spacing of bolts.
d) Provision of double washer (GI & asbestos or bituminous washers).
e) Proper installation of flashing.
f) Successful passing of all necessary relevant quality control tests.

1.11A I.S. Codes:

All relevant IS codes/CPWD/NBO/International Standards shall be followed. A few of them are mentioned below:

IS : 277  : Specification for GI sheets (Plain and Corrugated).

1.12 TECHNICAL SPECIFICATION FOR EMBANKMENT AND TURFING WORK:

1.12.1 EARTHWORK IN EMBANKMENT:

1.12.1.1 Masonry pillars will be constructed at suitable points in the area to serve as reference layout pillars and bench marks for the execution of the work. These bench marks shall be connected with other permanent bench marks approved by the Engineer. Necessary profiles with pillars, pegs, bamboos, string or ‘bur-jis’ etc. shall be made to show the correct formation level before the work is
started. The pillars, 'burjis' and profile etc. shall be made and maintained during the execution of the work by the contractor at his own cost.

The ground level shall be taken at 5 metres interval or larger intervals for uniformly sloping ground or as directed by the Engineer. The ground levels shall be recorded in field books which shall be signed by the contractor and the Engineer before the earthwork is started. The labour required for taking levels shall be taken for the purpose of determining the quantity of different types of earthwork.

1.12.1.2 The layout of the embankment shall be properly set our by the contractor. The foundation of the embankment shall be excavated to a depth of 50 cm from the virgin soil in more or less leveled ground and then ploughed to a depth of 15 to 30 cm. The foundations of embankment in the sloping ground shall be prepared in such a manner, as directed by the Engineer, to provide adequate bond with the embankment and to prevent slipping. The surface of the sloping ground below embankment need to be stepped, scarified, ploughed as per the instruction of the Engineer. All clods and lumps shall be broken into fine earth and roughly leveled. The surface may then be well watered before the earthwork is started, if the Engineer so desires. No extra shall be paid to the contractor for the preparation of foundation for the embankment.

1.12.1.3 Earth/spoils shall be obtained from cutting high grounds or from other excavations as directed by the Engineer. Filling for embankment shall be done by spreading the excavated spoils in uniform regular horizontal layers of not more than 15 cm including transportation of the excavated spoil from stack, breaking the lumps and clods of sizes bigger than 100 mm, dressing, leveling etc. The spoils shall be free from all roots, grass, vegetation, organic matters and rubbish etc. The filling shall be done true to line, levels etc. as per drawing and/or as directed by the Engineer.

Dwarf bunds shall be constructed by the contractor at his own cost over the embankment by excavated spoils before monsoon as per the instruction of the Engineer. The finished levels in case of compacted filling shall be kept after consolidation at least 12 mm higher per 150 mm of filling than the required grade to cater for future settlement. Ordinarily, only the materials satisfying the density requirement given in the table below shall be employed for embankment construction, unless relaxed by the Engineer-in-charge in particular case.
1.13 TECHNICAL SPECIFICATION FOR PLANT AREA ROADS & DRAINS:

1.13.1 SCOPE:

This specification covers all work required for cutting, filling, compacting, leveling and dressing, box cutting, soling, edging etc. required for the construction of water bound macadam roads, premix bituminous carpet topping, road side kutcha drains, pipe culverts etc.

1.13.2 GENERAL:

1.13.2.1 Work to be provided for by the Contractor:

The work to be provided for by the contractor, unless otherwise specified, shall include but not be limited to the following:

i) furnish all labour, supervision, services, materials, scaffolds, earthmoving equipment, tools and plants, transportation, water supply, necessary approaches etc. required for the work.

ii) submit to the Engineer progressively, the results of tests undertaken to assess the degree of compaction in the backfilling if required by the Engineer.

1.13.2.2 Information on site conditions:

The contour drawing showing the contour of the ground will be furnished to the Contractor. The contractor must satisfy himself of the character and volume of all work under this item and expected surface, sub-surface and/or sub-soil water to be encountered. He must also satisfy himself about general conditions of site and ascertain the existing and future obstruction likely to come up during the execution of the contract to carry out the work under this scope.

1.13.2.3 Codes and Standards:

All work under this specification, unless specified otherwise, shall conform to the latest revision and/or replacements of Indian Standard Specifications and Codes of Practice relevant to the work under the scope of this specification. In case any particular aspect of work is not covered specifically by Indian Standard Codes or this specification, any other standard practice as may be specified by the Engineer shall be followed.

1.13.2.4 Conformity with design:

Contractor shall carry out the work only as per the approved drawings prepared by him based on the design drawings issued to him from time to time or the detailed drawings issued to him and/or as directed by the Engineer.
1.13.2.5 Classification:

Classification as indicated on specification in chapter 2.1 (preparation of site and earthwork in foundations and trenches) shall be followed.

1.13.2.1 Materials to be used:

All materials required to carry out the work under the scope of this contract to the satisfaction of the Engineer shall be of best quality and shall be supplied by the Contractor.

1.13.2.6 Borrow Materials:

Borrow materials required for backfilling shall be excavated from approved locations and shall consist of granular materials free from roots, vegetation, decayed organic matter, normal salts and chemicals free from lumps and clods and shall be of uniform quality.

Arrangement for borrow materials from areas, stacks and/or sources other than plant property limit shall be done by the contractor at his own cost.

2.13.2.7 Quality Control:

The contractor shall establish and maintain quality control procedures for the various aspects of the work, methods, materials and equipment used. The quality control operation shall include but not be limited to the following items of work:

i) Lines, level, grades: Periodic surveys, establishment of markers and boards.

ii) Backfilling: Checking the quality of the fill materials, checking the degree of compaction by standard test, checking moisture content of soil.

1.13.3 EXECUTION:

1.13.3.1 Setting out:

The Contractor shall set out the work as per the approved drawings and as desired by the Engineer and carry the Bench Mark from a known reference as shown by the Engineer to the place of his work and fix permanent points, and markers for future reference. To show the correct formation level, necessary profiles with pegs, bamboo and strings etc. shall be made prior to the starting of the work. The permanent points and markers shall be checked by the Engineer and certified by him, after which the Contractor will proceed with the work. Before starting any work on excavation or back-filling, the existing ground levels shall be jointly recorded by the Engineer and the Contractor and certified by the Engineer and plotted on plans for the purpose of record and measurement. The levels should preferably be taken at an interval of 3 metres in two perpendicular directions but depending on the topography, the Engineer may instruct the contractor to take levels at any interval, the magnitude of which will be decided by the Engineer. It should be noted that the checking by the Engineer shall in no way absolve the contractor of his responsibilities of carrying out the work to true lines, levels, grades and subsequent correction at his own cost in case any error is noticed at any time.
1.13.3.1 Cleaning and Grubbing:

The area to be excavated or filled up with earth shall be cleared out of fences, trees, roots, logs, stumps, bushes, vegetation, rubbish, slush etc. and leveled up. The Engineer may at his discretion instruct certain trees or vegetation to be retained from aesthetic or other point of view. The contractor shall take due care and protect these while clearing the rest of the area.

1.13.4 EARTHWORK:

1.13.4.1 Cutting:

The earthwork in cutting for roads shall be done wherever necessary up to the finished road top level, maintaining proper gradient and camber as shown on drawings. Then, the cutting for berms shall be done to a depth as shown on drawings. The side slopes are to be kept as per the drawing or as instructed by the Engineer. The side slopes are to be dressed neatly to give a pleasing appearance. Any cutting done below the required levels and profiles shall be filled back at the contractor's cost with suitable materials with proper watering and ramming as decided by the Engineer.

1.13.4.2 Filling:

The earthwork in filling for embankments shall be done wherever necessary with the spoils obtained from the earthwork in cutting. The filling shall be done in layers of 150 mm. All big lumps, clods etc. shall be broken with mallets or approved appliances. Every layer of 150 mm shall be roughly leveled, compacted and thoroughly consolidated with proper ramming and watering before starting the next layer of filling. The contractor shall take all possible care for proper consolidation of the embankment. A compaction of 95% of the maximum density shall be obtained at optimum moisture.

Top width of embankments shall be as shown on drawings. The side slopes shall be as per the drawing or as instructed by the Engineer. Allowance for shrinkage shall be kept at the rate of 10 mm extra height for every one metre depth of filling.

Roots of trees, branches, leaves and other organic and deleterious materials shall be removed from the areas to be filled and from the excavated spoils, before filling is started.

Any damage to the embankments due to rains shall be made good by the Contractor at his own cost.

The sequence of cutting and filling shall be as instructed by the Engineer.

The tenderer shall mention the method of consolidation he wants to adopt for the execution of the contract. Consolidating by mechanical equipment is required.
1.13.4.3 Surplus Spoils:

If, after filling of the embankments with spoils from cutting, there is any surplus spoil, such surplus spoil shall be transported within a distance of 150 m and utilised in filling up of low areas within the plant area, as instructed by the Engineer. The filling shall be done in layers of 150 mm, clods and lumps shall be broken and consolidation done along with watering and ramming to the satisfaction of the engineer.

1.13.4.4 Lead :

Excavated earth shall be disposed in areas within 150 m of lead which shall be measured by the shortest route as a crow flies.

1.13.4.5 Lift :

Scope shall include work in all lifts.

1.13.5 BOX CUTTING :

1.13.5.1 Excavation :

After the earthwork in cutting and the earthwork in embankments have been done properly upto the final level with gradient and camber as per drawings and proper consolidation of the filling is completed, earthwork in box cutting shall be taken in hand. Before starting of box cutting, the contractor shall obtain Engineer's approval of cutting and embankment work.

The box cutting shall be done in such a way that the width of cutting is exactly the clear distance between the edging blocks. The depth of cutting shall be the total thickness of consolidated soling and road metalling. The formation shall have the same profile and camber as shown on drawings.

The excavated spoils shall be transported and utilised in filling of low areas within the plant area or as directed by the Engineer. The filling shall be done in layers of 150 mm, clods and lumps shall be broken and consolidation done to the satisfaction of the Engineer.

In case of presence of weak soil-pockets below the formation, the contractor shall excavate and remove such soil to an extent as instructed by the Engineer. The extra depth shall then be filled up with 38 mm and down stone-metal and voids in metal shall be filled up with moorum. Then the filling shall be rammed and rolled uniformly with a road-roller of 8 tonnes minimum weight. These operations of removing weak soil- pockets and filling with stone metal shall be done by the contractor and paid at the earthwork rates plus the cost of stone metal only.

If by mistake the depth of box cutting is made more than required, the Contractor shall make up the extra depth by metal consolidation, as specified above, at his own cost.
1.13.5.2 Rolling:

After the box-cutting is completed, the formation shall be rolled with a road-roller of 8 tonnes minimum weight, maintaining proper gradient and camber. Care shall be taken to avoid excessive rolling of the formation. If, after rolling, the formation is higher than required, the excess earth shall be removed by carefully cutting and dressing and the formation shall be rolled as specified above. In case after rolling the formation is depressed below the required level, the contractor shall continue the process of filling and rolling as above till the correct level is attained upto a limit as decided by the Engineer.

1.13.6 EDGING:

1.13.6.1 Materials:

The edging shall be of bricks as per the approved drawings during execution. The bricks shall be as per clause 2.13.11.

1.13.6.2 Laying:

After rolling of the box-cutting is completed, trenches shall be cut for edging. The width of the trenches shall be minimum and just sufficient to insert the edging bricks. The clear width between the inside faces of the edging bricks shall be exactly the same as shown on drawing. The inside faces shall be in plumb and the gap between the bricks shall not be more than 10 mm. The top of the edging shall be at the same level as shown on drawings. The inside faces shall be in plumb and the gap between the bricks shall not be more than 10 mm. The top of the edging shall be at the same level as shown on drawings and the inside face shall be in a neat line.

The edging bricks shall be thoroughly packed with a mixture of stone chips (50%) and moorum (50%) at the outside face. The laying and packing shall be done in a proper workman like manner acceptable to the Engineer.

If, after consolidation of the road-metalling, any portion of the edging is found to be out of line and level, the contractor shall take out the bricks and re-lay the same to the satisfaction of the engineer.

1.13.7 SUB-BASE:

1.13.7.1 Materials:

The sub-base shall be done with assorted rough stone boulders or quarried stone. The stone shall be tough and it shall not flake or crumble when being rolled with a road-roller of 8 tonnes minimum weight. No stone shall be less than 75 mm in thickness and shall not be more than the depth of soling as specified on drawings. The width of stone shall not exceed twice the thickness. The filling of bigger voids shall be done with smaller pieces of stone.
The smaller voids shall be filled with blinding material made with a mixture of small stones (50%) 25 mm down and moorum (50%).

1.13.7.2 Laying:

The soling stone shall be laid on its narrowest side closely on the formation so that minimum voids are left between the adjacent blocks. The bigger voids shall be filled up by wedging in smaller blocks of suitable size with hand hammer. The laying of blocks and wedging smaller blocks shall be such that the soling shall be a compact mass with minimum voids and shall not move when being rolled for consolidation.

Then the blinding material, (50%) small stone plus 50% moorum, shall be spread over the soling and worked into the voids by brooms. The blinding material shall be sufficient to fill up all voids and to produce an even surface after rolling. Excess use of blinding material shall be avoided.

1.13.7.3 Rolling:

The stone soling shall be thoroughly consolidated with power roller of minimum 8 tonnes weight, starting at edges and working towards the centre.

The rolling shall be done in such a way that the whole soling shall give a compact base without any voids. After initial rolling is done, inspection shall be made to see if voids are still left in the soling. If all voids are not filled up, further blinding material shall be added. The rolling shall be continued till there is no settlement of voids and the surface is true and even. The finished soling shall give the correct thickness, gradient and camber as specified on drawings. 1.17.4 Bad Workmanship:

If the Engineer finds that the soling done is not upto the specifications, the whole soling over the defective portion shall be taken out, re-laid and compacted with roller as specified above by the contractor at his own cost.

1.13.8 METALLING (WATER BOUND MACADAM):

In general all relevant IS codes/CPWD/NBO/International Standards /MOST specifications shall be followed:

1.13.8.1 Materials:

The road metal shall consist of 38 mm down graded approved quality crushed stones. The metal shall be of close, tough, durable and hard texture and shall not flake or crush under pressure. The metal shall be of granite, basalt or equivalent quality with high density and shall not absorb, when immersed in water for 24 hours, more than 1 percent of own weight. In general, unless oth-
otherwise specified, the metal shall conform to the standards laid down by the "Indian Road congress" regarding toughness, abrasion, coefficient of hardness, attrition loss and cementation values. The grading of the metal shall be such that not more than 5% by weight shall be retained on 38 mm sieve and not more than 50% to 65% retained on 25 mm sieve, not more than 10 to 15% by weight retained on 20 mm sieve, but 100% shall be retained on 12 mm sieve.

Metal shall be screened, if so desired by the Engineer and fines from 12 mm to dust screened out and may be used as blinding if found suitable by the Engineer.

1.13.8.2 Laying:

The metal shall be laid to camber and profile in such a way that the total thickness of loose metal over stone soling is not less than 150 mm but more shall be used, if required to make the consolidated thickness at least 100 mm after rolling. While spreading the metal, proper profile and camber shall be maintained and checked with templates at every 6 to 7 metres. No rolling shall be done until laying has been approved by the Engineer.

1.13.8.3 Rolling:

a) Dry Rolling:

After metals have been laid and dressed as above, metals shall be rolled dry with a Road Roller of 8 tonnes minimum weight until well compacted and there is no appreciable movement of the stone or wave in front of the advancing roller is noticed and no lines of roller are left on the surface. Excessive dry rolling should also be avoided.

When the desired degree of compaction has been obtained by dry rolling, screening of approved chipping 12 mm down in size should be spread uniformly over the surface by brooming and this should be pushed into the interstices by rolling, successive layers of screening being added till no more chippings are being taken up by the surface. Any unevenness observed shall be rectified by removing stones up to a depth of 2" to 3", refilling the same, hand packing and re-rolling. No watering should be done till this process is complete. The amount of screening used should not be less than 1 cu m per 100 sq.m of road surface (31/2 cft per 100 sq.ft.)

Rolling operation has to be very carefully carried out. Rolling should be done commencing from the edges of the road and working towards the centre. Roller should be passed equal and sufficient number of times on the metal
spread at every stage so as to secure equal and thorough compaction. Speed of roller has to be very slow and uniform and reversing shall be quick and free from jerks. As far as possible, the reversing process should be at different sections of the length rolled during each successive trip.

b) Wet Rolling (Water bound Macadam):

When the dry rolling has been completed to the satisfaction of the Engineer the surface is to be watered and kept saturated and rolled a few turns as specified above. Approved quality blindage (moorum) shall then be spread uniformly over the surface to a thickness of 20 mm to 12 mm. The roller wheels as well as the road surface should be constantly watered during wet rolling process. The rolling should be continued until a slurry is formed over the entire surface and the same moves in the form of a wave in front of the roller when the rolling operation may end and the surface allowed to dry. The finished metalling shall be minimum 100 mm thick. The finished surface shall be smooth and uniform, free from waviness and corrugations and as per specified profile and camber.

After 24 hours of rolling, the surface shall be sprinkled with a thin layer of sand not less then 2 cft. per 100 aft. or 56 cum per 100 sq.m of road surface. Traffic shall be allowed after four days from the day of sprinkling the sand or as approved by the Engineer.

1.13.8.4 Bad Workmanship:

The compaction and finish shall be as per specifications and to the satisfaction of the Engineer. If the Engineer so desires, the defective portions shall be removed, re-laid and compacted, as specified above, by the contractor at his own cost.

1.13.9 ROAD SIDE KUTCHA DRAINS:

1.13.9.1 Formation of Drains:

The road side kutcha drains shall be made in sizes and slopes as shown on drawings and/or as instructed by the Engineer. The minimum side slope shall be 1 vertical to 1 horizontal or as instructed by the Engineer. The sides of the bottom shall be neatly dressed after excavation. Proper connections shall be made to the culverts, as per instructions of the Engineer.

The excavated spoils shall be transported and filled in low areas within the plant area or in embankments within 150 metres lead and in all lifts as instructed by the Engineer. The filling shall be done in 150 mm layers, lumps
and clods shall be broken and then compacted properly.

1.13.10 CULVERTS :

1.13.10.1 General :

Excavation in trenches for foundation of culverts and wing walls shall be done with side slopes of one vertical to 1/2 horizontal after clearing the site etc. as per specifications of earthwork in clause No.2.13.4, backfilling with ramming and watering shall be done after construction of the foundations.

1.13.11 BRICKWORK :

1.13.11.1 Materials and Workmanship :

All bricks shall be of class designation A-50, well burnt, well shaped, made of good earth for brick. Bricks shall be soaked in water for at least one hour prior to use and shall be laid truly horizontal and vertical in headers and stretchers with cement mortar consisting of one part of cement and four parts of sand in layers not exceeding 60" in height. Each layer shall be allowed at least 24 hours to settle itself before another layer is placed on it and every layer cured with water until the starting of next layer above it.

Materials for mortar such as sand and cement shall be of standard specifications. Mortar shall be well mixed, first dry mixed and then by adding water slowly to have a thick workable consistency. Mortar shall be mixed in small batches consistent with the rate of consumption so that no mortar is used after one hour of mixing.

Mortar joints should be 10 mm thick and all joints should be full of mortar. Brickwork shall be carried up regularly in plumb every course being horizontal. No vertical joints shall come directly over one another.

Joints of the brickwork shall be raked 12 mm deep. The brickwork shall be kept moist for 14 days.

1.13.11.2 Plaster to Brickwork :

Brickwork shall be plastered with cement mortar -1 part by volume of cement to 4 parts by volume of clean, sharp, well graded sand. The thickness of the plaster shall be 20 mm and shall be done after cleaning and wetting the brick joints. Plaster shall be cured for 14 days. All plaster work shall correspond to IS: 1661 - latest edition.
1.13.12 PIPE CULVERTS :

1.13.12.1 Materials :

Pipe culverts shall be made of reinforced concrete pipe (Hume pipe) and shall be of class No.2. All pipes shall meet the requirements of IS: 458 (latest edition) and shall be procured from approved manufacturers with collars as per manufacturers' standard specification. The tenderer shall specifically mention the particular manufacturer's product he proposes to use.

Cement shall be ordinary Portland Cement as per IS: 269 (latest edition).
Aggregates shall be as per IS: 383 (latest edition). Maximum size shall not exceed one third the thickness of the pipe or 20 mm, whichever is smaller. For bedding concrete for laying the pipes, the maximum size of aggregate shall be 38 mm.

Fine aggregate for concrete shall be as per IS: 383 (latest edition).

1.13.12.2 Laying :

Laying of concrete pipes shall correspond to IS: 783 - latest edition and to specification given below:

a) The excavation for laying pipes and foundation of drop wall should be made as shown on drawings. Side slopes of excavation shall be one vertical to half horizontal. Half metre of working space shall be allowed on either side of pipe exterior. Side slope, shoring, bailing out water etc., as required, shall be done by the contractor.

Side slips, if there by any, shall be removed by the Contractor without any extra cost to the Owner. After laying of the pipes are completed, backfilling of the trenches shall be done in layers of 150 mm, clods and lumps broken, watered and compacted with iron rammers to the satisfaction of the Engineer. The surplus spoils shall be transported and filled in low areas within the plant area, as instructed by the Engineer. The filling shall be done as already specified earlier.

b) Pipe bedding shall be first class projection bedding as per IS: 783 (latest edition) having a projection ratio of not greater than 0.70, in which the pipe is carefully bedded on fine granular materials in an earth foundation carefully shaped to fit the lower part of the pipe exterior for at least ten percent of its overall height and in which earth filling material is thoroughly rammed and tamped in layers not exceeding 150 mm in depth, around the pipe for the remainder of the lower 30 percent of its height.
c) The drop walls shall be first class brickwork in 1:4 cement mortar as already specified under clause 2.13.11 'Brickwork'.

d) The pipe culverts shall be made with proper care regarding the invert of the pipe, gradient, if any, etc. as specified on drawings and/or as instructed by the Engineer.

1.13.13 PRE-MIX BITUMINOUS CARPET TOPPING (50 MM):

a) Description:

This carpet topping shall be composed of crushed aggregate penetrated with bituminous binder, constructed on a prepared base course, dragged and bladed as required to produce thorough coating of the aggregate. It shall have a thickness of 50 mm after compaction and before application of the seal coat, unless otherwise indicated on the drawings.

b) Materials:

i) Binder: The binder shall be bitumen of suitable grade as per Indian Standard Code of Practice IS: 73, IS: 217 and IS: 454 and shall preferably be of grade A-90 and/or S-90 of IS: 73 equivalent.

ii) Stone Aggregate: The stone aggregates shall consist of angular fragments of clean, hard, tough, durable rock of uniform quality throughout. They should be free of elongated or flaky pieces, soft or disintegrated stone, vegetable or other deleterious matter.

iii) Sand: The sand shall consist of clean, hard, durable, uncoated coarse dry particles and shall be free from injurious amounts of dust, soft or flaky particles or organic matter or other deleterious substances.

c) Quantities of Materials Required:

i) For Carpet:

<table>
<thead>
<tr>
<th>Materials</th>
<th>Quantity per 10M² of road surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stone Aggregates:</td>
<td></td>
</tr>
<tr>
<td>12 mm passing 20 mm square mesh, retained on 10 mm square mesh.</td>
<td>0.366 Cu.m</td>
</tr>
<tr>
<td>10 mm passing 12 mm square mesh, retained on 6 mm square mesh.</td>
<td>0.18 Cu.m</td>
</tr>
<tr>
<td>Binder:</td>
<td></td>
</tr>
<tr>
<td>For 0.366 Cu.m 12 mm stone aggregates at 52 Kg per Cu.m</td>
<td>19.04 Kg.</td>
</tr>
<tr>
<td>For 0.18 Cu.m 10 mm stone aggregates at 60 Kg per Cu.m</td>
<td>10.80 Kg.</td>
</tr>
</tbody>
</table>
For Tack Coat Binder:
- On water-bound macadam surface: 14.64 to 19.52 Kg.
- On existing black top surface: 11.72 to 14.64 Kg.

For Seal Coat:
- Medium coarse sand passing I.S. Sieve No. 170 and retained on I.S. Sieve No. 18: 0.12 Cu.m
- Binder: 13.66 Kg.

Construction:

i) Preparation of Base: Before the carpet is applied to the existing base, the road must be absolutely free from dust or caked mud. Where the existing base pot-holes are rutted, these irregularities must be filled in with pre-mixed aggregates and well rammed, about a weak before the carpet is laid.

The surface should be cleaned by removing caked earth and other foreign matter with wire brushes, sweeping with brooms and finally dusting with sacks.

ii) Tack Coat: The binder should be heated wherever required to appropriate temperature and applied to the base at the rate specified in Clause - c(ii) above. The binder should be evenly brushed. The tack coat should be applied just ahead of the spreading of the premix.

iii) Preparation of Premix: Mechanical mixers should be preferred. When improvised hand mixing drum is used for premixing, place 0.30 Cu.m of 12 mm aggregate and 0.015 Cu.m of 10 mm aggregates in the mixing drum and thoroughly mix dry. Where straight run bitumen is used, the aggregates should be suitably warmed prior to adding bitumen.

Add 2.48 Kg of binder as per Clause - c(i) above, heated, wherever required, to a temperature suitable for the grade of bitumen used and mixed until the aggregates are thoroughly coated with binder. After thorough mixing, the pre-mix to be emptied on stretchers of wheel barrows and carried to site. The quantities of aggregates and binder per batch as given above may be proportionately increased if proper coating is possible in one operation.

iv) Spreading of Premix: Immediately after applying the tack coat, spread the premix with rakes to the desired thickness and correct camber or distribute evenly by means of a drag spreader.

v) Rolling: As soon as sufficient length, say 15 metres of premix has been laid, rolling is to be commenced with rollers approved by the Engineer. Rolling should commence at the edges and progress towards the centre longitudinally. When the roller has passed once over the whole area, any high spots or depressions which become apparent should be corrected by removing or adding premix and rolling to compaction. Excessive rolling should be avoided.
At intervals roller wheels to be moistened to prevent the premix from adhering to the wheels.

vi) Seal Coat: The seal coat should be applied immediately after laying of the carpet and rolled. Materials required for the seal coat shall be as per clause - c(iii) above.

1.13.14 REPAIR OF EXISTING WATER-BOUND MACADAM SURFACE:

Pot holes or patches and ruts in water-bound macadam base or surface course, which are to be surface treated, shall be repaired by removal of all loose material by cutting in rectangular patches and replacing with suitable materials. For the purpose of repairs, the area of pot holes shall be taken upto 0.75 Sq.m and depth upto 4 Cu.m. The repairs shall be done as under:

All pot holes, patches and ruts 4 cm deep shall be repaired and brought to level with premix as specified above with proper consolidation and payment to be made as per premix item. Depths greater than 4 cm shall be repaired with similar specification as adopted originally of for water bound macadam road.

The above is only applicable in case of damage to the existing water-bound macadam surfaces. In case, however, it is found that there has been damage to the soling as well, the area of the damaged surface shall be repaired by removal of the soling materials and relaid with stone boulders and soling done as per original specifications, surfaced with water-bound stone metal as specified in original work for soling and water-bound macadam surfacing.

1.14 TECHNICAL SPECIFICATION FOR GROUTING:

1.14.1 GROUTING OF COLUMN BASES:

1.14.1.1 General:

Grouting under column bases constitute a special kind of work requiring judicious selection of materials and careful execution of work. Grouting should ensure complete filling of the space and perfect bond. The grouting shall be done under expert supervision. Care must be taken to ensure that there is no locked air in the grouting.

1.14.1.2 Materials:

1.14.1.2.1 Cement:

Cement used shall be any of the material mentioned in clause 5.1 of IS:456-2000 as per requirement. only fresh cement shall be used.
1.14.1.2.2 Sand :

Fine aggregate shall comply in general with requirements of concrete aggregate (IS:383) and shall have a fineness modulus of 2.5 to 3.0.

1.14.1.2.1 Anti-Shrinkage material :

Aluminium powder or anti-shrinkage admixture like Groutex CRS - NS grout (by Cement Research Institute of India) or its equivalent shall be of standard brand from reputed manufacturers and shall be approved by the Engineer prior to use in work.

1.14.1.3 Mortar :

Water cement ratio should not exceed 0.5. Mortar shall be made up of cement and sand in the proportion 1:1 by weight and blended with aluminium powder (about 0.005% by weight of cement or with anti-shrinkage admixture) in a suitable proportion to cement mortar in accordance with the recommendation of the manufacturer and subject to the approval of the Engineer.

If directed by the Engineer 6 mm down stone chips may have to be added in the mix.

1.14.1.4 Surface preparation : Concrete :-Concrete surfaces receiving the grout shall be properly roughened removing laitance and exposing good concrete. The preparation of the surface may be accomplished through the use of a chipping hammer or a hand bush hammer and wire brush. The surface shall be thoroughly cleaned removing all the free water from the surface but keeping it wet before the grouting begins.

1.14.1.5 Surface preparation : Steel :-The steel surfaces coming in contact with the grout should be cleaned of rust, mill scales, paints, oil or grease and be wet before setting into place for grouting.

1.14.1.6 Workmanship :

Grouting arrangements should ensure mortar to fill all the voids completely. Provisions of grout holes and rodding arrangements should be checked before commencement of grouting. If necessary, pressure grouting with grout pump shall be restored to.

1.14.1.7 Method of Grouting :

1.14.1.7.1 Use of dry pack concrete :

The widely used method of obtaining satisfactory grout is based on principle of using lowest water cement ratio reducing the shrinkage to a minimum. Poz-zolana cement having less shrinkage than ordinary Portland Cement is preferred for this grouting. Only enough water shall be added to produce a grout. The proper amount of mixing water and proper consistency are those which will produce a grout which is at the point of becoming rubbery when the material is solidly packed. Any mortar, which has been mixed for a period longer than an hour, shall not be used.

1.14.1.7.2 Use of special Admixture :

To reduce the shrinkage anti-shrinkage materials as specified earlier to be added.
1.14.1.7.3 Scope:

The work covers all operation connected with grouting including all labour and materials. Any damage to the concrete foundation works caused during such operations due to the carelessness or negligence shall be made good by the Contractor in a manner to be decided by the Engineer, whose decision shall be final and binding.

1.14.2 DISMANTLING, ALTERATION & RE-ERECTION OF STEEL WORK:

In case it is found that alterations are to be done for certain portions of steel work already erected for any reasons whatsoever, this shall be done only on the written orders of the Engineer. Complete scheme of alterations shall be detailed and got approved by Engineer before work is taken up at site.

The sections requiring modifications which cannot be done in the erected position shall be dismantled carefully without damaging other structures, lowered and transported to the workshop. These operations may include temporary dismantling, cutting, re-welding or supporting, re-aligning of other adjacent connected member as well.

1.15 TECHNICAL SPECIFICATION FOR SHEETING WORK IN ROOF AND SIDING:

1.15.1 SCOPE:

This specification covers the erections of aluminium sheet covering to roof and side walls at various elevations and the fabrication and/or installation of ridge/hips etc. as shown on drawings and schedule of items.

1.15.2 INSTALLATION:

1.15.2.1 Storage of Materials:

All materials shall be stored by the contractor in proper way to prevent any damage through bending at sheet corners and edges. Storage should be such as to keep the sheets dry as water trapped between sheet surfaces in close proximity may lead to unsightly staining. The sheets should be kept off the ground and covered suitably. The stacks of loose sheets should not be too high as this may lead to spreading of bottom sheets. The sheets should be stacked in horizontal or inclined position as stacking on edges can lead to damage of edges and corners.

1.15.2.2 Workmanship:

Workmanship shall be according to best construction practices to give a water tight finish to the satisfaction of the Engineer.
1.15.2.2.1 Aluminium sheeting and ridges side laps shall be 1 1/2 corrugation for roof and 1 corrugation for side sheeting. The fixtures should pass through the crown for roofing while for side sheeting the holes should be covered so as to have a tight finish when fitted with bitumen washers. Sheets shall be secured to sheet framing by 8 mm dia hot dupgalvanised or cadmium plated sheet J or U hocks shall be maximum 305 mm apart. The length of the J or U hooks or bolts shall be to suit the sectionus of the bearer. Sheet shall also be bolted at the ends at every third corrugation with 6 mm dia galvanised iron seam bolts and G. I. flat washers and bitumen washers.

1.15.2.2.2 Fibre glass reinforced plastic translucent sheeting:

These shall be of thickness and profile as mentioned in the schedule of items. Light transmittance shall be about 60 to 70 %. The installation should be such that it fits with the aluminium/CGI/Polysteel coloured (as applicable) sheet corrugations and is completely watertight and is able to withstand the designed wind pressure. The end and side laps and fixing device shall be same as used in general sheeting. Where used in lieu of glass, the fixing shall be by means of timber or metal glazing beads as mentioned in schedule of items or elsewhere.

1.15.3 Acceptance Criteria:

The installations shall present a neat appearance and shall be checked for water tightness. The following shall be checked:

a) Side laps and lap with ridge.
b) Absence of cracks, bends, holes or damages in sheets.
c) Spacing of bolts.
d) Provision of curved aluminium washer and bitumen washer.
e) Passing of all necessary relevant quality control tests.

1.15.4 IS Codes:

All relevant IS codes/CPWD/NBO/International Standards shall be followed. A few of them are mentioned below:

1.16 TECHNICAL SPECIFICATION FOR SOIL INVESTIGATION WORK:

1.16.1 SCOPE:
This specification is intended to cover the complete soil exploration of the plant area, as elaborated hereunder:

1.16.1.1 Making test bores on soil including taking out requisite number of undisturbed samples at different depths for laboratory tests, making standard penetration tests at different depths, recording ground water levels, maintaining driving record, preparation of borehole log for each borehole etc.
1.16.1.2 Conducting direct load test including cyclic loading and unloading operations wherever required. (plate bearing load tests).
1.16.1.3 Laboratory tests on collected samples for determining natural moisture content, particle size analysis, index properties, wet and dry density, unconfined compression test, shear test by triaxial compression, consolidation tests, permeability tests, swelling pressure etc.
1.16.1.4 If rock is encountered, drilling through rock upto 3M or 90% core recovery is obtained, including core recovery and determination of crushing strength of rock samples.
1.16.1.5 Direct undisturbed soil sample testing by open trial pit.
1.16.1.6 Preparation and submission of a comprehensive soil report with recommendations for type of foundation, allowable bearing capacities for shallow foundation considering shear as well as settlement criteria, method of deep excavation, probable settlement for foundations etc.
1.16.1.7 Location of boring for direct load test and open trial pit shall be shown tentatively by the Engineer. Before carrying out the tests prior approval should be taken from the Consultants/Owner regarding the location of any test.
1.16.1.8 RECORDS:
All field records shall be submitted to the Engineer in duplicate as and when they are recorded during the process of soil investigation.

1.16.2 TEST BORING:
Test boring through different layers of soil shall be carried out by the Contractor at the locations as at such places within the plant area as directed by the Engineer in a manner described below. Depth of boring shall be 20M or refusal strata, whichever is lesser, below the natural ground level. If the present formation level is above the natural ground with filled up soil, the depth of boring mentioned shall exclude such filled up soil. Various methods of boring are described in IS code of practice IS:1892 (latest revision), which may be adopted.

Preferably it shall be auger type boring with boring diameter not less than 150M and should be carried out in such type of soil as found in the site. However, the
The contractor shall describe in detail the equipment and method of boring he proposes to use. Samples of undisturbed soil shall be obtained preferably at every 1.5M or where a change in strata is indicated but in no case, more than 2M and a sample shall be obtained on the average for every 2 M depth of boring, since it is intended to ascertain the characteristics of the soil at various depths. If, however, there is fair uniformity in the characteristics of the soil of samples stipulated above.

Ground water level for each borehole shall be checked during boring operation and shall be recorded in bore log. The contractor shall maintain a bore log for each soil test boring on an approved proforma. Records of driving the sampler, number of blows and penetration shall be maintained for each bore hole depth-wise. IS: 2131 (latest edition) should be followed for additional information. The contractor shall furnish the complete bore log and record of penetration duly verified and signed by the Engineer at site and submit them in duplicate to the Engineer.

1.16.3 DIRECT LOAD TEST ON SOIL:

The actual locations of the proposed tests shall be decided by the Engineer. The test shall be carried out as described in IS:1888 (latest revision)-"Method of Load Tests on Soils" unless otherwise specifically directed. The application of load may be by gravity or by reaction method as detailed out in the Indian Standard. The tenderer shall furnish in his tender the complete detail of the equipment and the method he proposes to follow at site while loading the test plate. However, the contractor shall have to modify the arrangement at his own cost if it is ultimately found to be deficient. The depth of soil below ground level for each test shall be as per design requirement. The excavation and side protection during the test and backfilling after the test shall be carried out by the Contractor.

While releasing the loads the rebounds shall be observed in the similar manner as that for settlement observations. For load test point, minimum five cycles of loading and unloading operations shall be done at each loading stage upto the anticipated design value or yield value whichever reaches earlier. The observations shall be recorded directly in log books, proforma of which has to be approved by the Engineer, who shall also be present to check the data. The Engineer shall be notified well in advance of the detailed programme of the test and shall also be informed prior to start of releasing the load at each stage so that the total settlement can be checked by him. The recorded observations in duplicate shall be handed over to the Engineer.

1.16.4 LABORATORY TEST OF SOIL SAMPLES:

The adequate number of test samples of soil shall have to be collected from site and transported carefully to approved laboratory for carrying out necessary tests. The laboratory tests shall be carried out as specified in the Table.
appended to this specification or as decided by the Engineer. The method and procedure of testing to be followed shall be submitted to the Engineer in sextuplicate duly signed by the laboratory in-charge. The number of samples should be taken as specified in clause no. 2.16.2.

1.16.5 OPEN TRIAL PITS:
The location of open trial pits shall be as decided by the Engineer. The excavation of trial pits shall be up to a depth of 3M or not below the ground water table or as directed by the Engineer. In no case the depth shall be extended over 5M. The size of pits shall be 1M X 1M or as directed by the Engineer. The contractor shall provide a suitable access to the bottom of the pit and undisturbed soil samples shall be taken wherever directed.

1.16.6 REPORT ON SOIL INVESTIGATION:
The contractor shall make analysis of soil data as collected by him in the field and approved by the Engineer as well as field tests and laboratory tests. A comprehensive report shall have to be prepared by him finally incorporating all the data collected in proper tabular forms or otherwise along with specific recommendations. The report shall be submitted in sextuplicate to the Engineer for his review and approval.

1.16.7 IS CODES:
All latest relevant IS codes/CPWD/NBO/International Standards shall be followed. A few of them are mentioned below:

<table>
<thead>
<tr>
<th>Code</th>
<th>Latest</th>
<th>Description</th>
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<tr>
<td>IS: 1888</td>
<td>Latest</td>
<td>Method of Load Tests on soils.</td>
</tr>
<tr>
<td>IS: 2131</td>
<td>Latest</td>
<td>Standard penetration tests for soils.</td>
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<td>IS: 1892</td>
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<td>Site investigation.</td>
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<td>IS: 1498</td>
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<tr>
<td>IS: 2720</td>
<td>Latest</td>
<td>Method of test of soils.</td>
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1.17 TECHNICAL SPECIFICATION FOR FLOOR FINISHING AND ALLIED WORKS:

1.17.1 SCOPE:
This specification covers furnishing, installation, finishing, curing, testing, protection, maintenance till handing over the various types of floor finishes and allied items of work as listed below:
1.17.1.1 In situ finishes:

i. Integral finish to concrete base.
ii. Red oxide of iron finish.
iii. Terrazzo finish.
iv. Granolithic finish.
vi. Metallic hardware like 'Ironite' finish.
vii. Mastic asphalt finish.
viii. Chemical resistant finish.

1.17.1.2 Tiled finished:

i. Terrazzo tile.
ii. Chequered tile.
iii. Glazed tile.
iv. Tesserae (mosaic etc.).
v. Chemical resistant.
vi. Rubber, vinyl etc. Stone slab.
1.17.1.3 Base: The base to receive the finish is covered under other relevant specification.

1.17.1.4 Sequence:

Commencement, scheduling and sequence of the finishing works shall be planned in detail and must be specifically approved by the Engineer keeping in view the activities of other agencies working in the area. However, the contractor for the finishing items shall remain fully responsible for all the normal precautions and vigilance to prevent any damage whatsoever till handing over.

1.17.2 INSTALLATION:

1.17.2.1 Special Materials:

Special materials required for individual finishing items are specified under respective items. In general, all such materials shall be as per relevant I.S Codes where available. In all cases these materials shall be of the best quality available indigenously unless specified otherwise.

The materials for finishing items must be procured from well reputed specialised manufacturers and on the basis of approval of samples by the Engineer. The materials shall be ordered, procured and stored well in advance to avoid compulsion to use sub-standard items to maintain the construction schedule.

1.17.2.2 Workmanship:

Only workers specially experienced in particular items of finishing work shall be engaged. Where such workers are not readily available, experienced supervisors recommended by the manufacturer shall be engaged with the Engineer's permission. In particular cases where the Engineer so desires the contractor shall get the finishing items installed by the manufacturer.

1.17.2.3 Preparation of the base surface:

The surface to be treated shall be thoroughly examined by the contractor. Any rectification necessary shall be brought to the notice of the Engineer and his approval shall be taken regarding method and extent of such rectification work.

For all types of flooring, skirting, dado and similar locations, the base to receive the finish shall be adequately roughened by chipping, raking out joints and cleaning thoroughly all dirt, grease etc. with water, hand brush and detergent, if required, unless otherwise directed by the manufacturer of any
special finishing materials or specifically indicated in this specification under individual item.

To prevent absorption of water from the finishing treatment the base shall be thoroughly soaked with water and all excess water mopped up. The surface shall be bone dry where adhesives are used for fixing the finishes.

Prior to commencement of actual finishing work the approval of the Engineer shall be taken as to the acceptability of the surface.

1.17.2.3.1 In Situ Finishes:

1.17.2.3.1.1 Integral Finishes to concrete base:

While the surface of the concrete laid as per specification for 'Cement concrete' has been fully compacted and leveled but the concrete is still 'green', a thick slurry made with neat cement shall be applied evenly and worked in with iron floats. Then the slurry starts to set, it shall be pressed with iron floats to have a firm compact smooth surface without any trowel mark or undulations. This finish shall be as thin as possible by using 2.2 Kg of cement per Sq.m of area.

The surface shall be kept in shade for 24 hours and then cured for at least 7 days continuously by flooding with water. The surface shall not be subjected to any load or abrasion till 21 days after laying.

As desired by the Engineer the surface, while still 'green' shall be indented by pressing strings. The markings shall be of even depth, in straight lines and the panels shall be of uniform and symmetrical patterns.

1.17.2.3.1.2 Red Oxide of Iron Finish:

It shall consist of an under bed and topping over already laid and matured concrete base.

a. Thickness:

Unless otherwise specified the total thickness of the finish shall be minimum 40 mm for horizontal and 25 mm for vertical surface of which the topping shall not be less than 10 mm. While the topping shall be of uniform thickness the underbed may vary in thickness to provide necessary slopes. The vertical surface shall project out 6 mm from the adjacent plaster or other finishes. Necessary cutting into the surface receiving the finish shall be done to accommodate the specified thickness.

All junctions of vertical with horizontal shall be rounded neatly to uniform radius of 25 mm.
b. Mix :
   i. Underbed :

   The underbed for floors and similar horizontal surfaces shall consist of a mix of 1 part cement, 2 parts coarse sand AND 4 parts 10 mm down graded stone chips by volume. For vertical and similar surfaces the mix shall consist of 1 part cement to 3 parts coarse sand by volume.

   ii. Topping :

   For the topping cement, screened through a fine mesh and red oxide of iron pigment powder similarly screened shall be dry mixed thoroughly in right proportions to produce the desired colour when laid. The mix shall then be prepared with 1 part cement (mixed with pigment) and 3 parts coarse sand by volume. The whole quantity required for each visible area shall be prepared in one batch to ensure uniform colour.

c. Laying :

   The underbed shall be laid in panels of maximum area 5 sq.m each and no side shall be more than 2.5 m long. For outdoor locations the maximum area shall be 2.0 sq.m. The forms for the panels shall have perfectly aligned edges to the full depth of the total thickness of finish. If specified aluminium or glass dividing strips shall be used.

   The panels shall be laid in alternate bays or in chequered board pattern. No panel shall be cast in contact with another already laid until the contraction of the latter has taken place.

   The underbed shall be laid, compacted, leveled and brought to proper grade with a screed or float. The topping shall be placed after about 24 hours while the underbed is still somewhat 'green' but firm enough to receive the topping. The surface of the underbed shall be roughened for better bonding. The topping shall be rolled for horizontal areas and thrown and pressed for vertical areas to extract all superfluous cement and water to achieve a compact dense mass fully bonded with the underbed. The topping shall be leveled up by trowelling and finished smooth with a slurry made with already prepared cement and pigment mixture. About 2.0 Kg of the mixture shall be consumed per sq.m for horizontal surface and 1.0 Kg for vertical surface. The surface shall be cured for seven days by keeping it moist.

d. Polishing :

   About 36 hours after laying when the surface has hardened sufficiently it shall be polished with polishing stone till a smooth thin surface to the satisfaction of the Engineer is achieved. The finish shall be washed and cleaned just before handing over.
1.17.2.3.1.3 In Situ Terrazzo Finish:

It shall consist of an underbed and a topping laid over an already laid and matured concrete base.

a. Thickness:

Unless otherwise specified the total thickness of the finish shall be minimum 40 mm for horizontal and 25 mm for vertical surface of which the topping shall be not less than 10 mm. While the topping shall be of uniform thickness the underbed may vary in thickness to provide necessary slopes. The vertical surface shall project out 6 mm from the adjacent plaster or other finishes. Necessary cutting into the surface receiving the finish shall be done to accommodate the specified thickness.

All junctions of vertical with horizontal shall be rounded neatly to uniform radius of 25 mm.

b. Mix:

i. Underbed:
The underbed for floors and similar horizontal surfaces shall consist of a mix of 1 part cement, 1.5 parts sand and 3 parts stone chips by volume. For vertical surface the mix shall consist of 1 part cement to 3 parts sand by volume. The sand shall be coarse. The stone chips shall be 10 mm down well graded. Only sufficient water shall be added to give a workable consistency.

ii. Topping:
The mix for the topping shall be composed of cement, colour pigment, marble dust and marble chips. Proportions of the ingredients shall be such as to produce the terrazzo of colour, texture and pattern approved by the Engineer. The cement shall be white or grey or a mixture of two to which pigment shall be added to achieve the desired colour. To 3 parts of this mixture, 1 part marble powder by volume shall be added and thoroughly mixed dry. To 1 part of this mix, 1 to 1.5 parts of marble chips by volume shall be added and thoroughly mixed dry again.

The pigment must be stable and non fading. It must be very finely ground. The marble powder shall be from white marble and shall be finer than I.S Sieve No. 30. The size of marble chips may be between 1 mm to 20 mm.

Sufficient quantity to cover each visible areas shall be prepared in one lot to ensure uniform colour. Water to make it just workable shall be added to a quantity that can be used up immediately before it starts to set.

c. Laying:
The underbed shall be laid in panels. The panels shall not be more than 5 sq.m in area of which no side shall be more than 2.5 m long. For exposed lo
cations the maximum area of a panel shall be 2.0 sq.m.

The panels shall be laid in alternate bays or chequered board pattern. No panel shall be cast in contact with another already laid until the latter has contracted to the full extent.

Dividing strips made of aluminium or glass shall be used for forming the panels. The strips shall exactly match the total depth of underbed plus topping.

After laying, the underbed shall be levelled compacted and brought to proper grade with a screed or float. The topping shall be laid after about 24 hours while the underbed is still somewhat 'green' but firm enough to receive the topping. A slurry of the mixture of cement and pigment already made shall be spread evenly and brushed in just before laying the topping. The topping shall be rolled for horizontal areas and thrown and pressed for vertical areas to extract all superfluous cement and water and to achieve a compact dense mass fully bonded with the underbed. The surface of the topping shall be trowelled over, pressed and brought to a smooth dense surface showing a minimum 75% area covered by marble chips in an even pattern of distribution.

d. Curing:

The surface shall be left for curing for about 12 to 18 hours and then cured by allowing water to stand on the surface or by covering with wet sack for four days.

e. Grinding and Polishing:

When the surface has sufficiently hardened it shall be watered and ground evenly with rapid cutting coarse grade (No.60) grit blocks, till the marble chips are exposed and the surface is smooth. Then the surface shall be thoroughly washed and cleaned. A grout with already prepared mixture of cement and pigment shall be applied to fill up all pin holes. This surface shall be cured for 7 days by keeping it moist and then ground with fine grit blocks (No.120). It shall again be cleaned with water, the slurry applied again to fill up and pin hole that might have appeared and allowed to be cured again for 5 days. Finally the surface is ground a third time with very fine grit blocks (No.320) to get smooth surface without any pin hole. The grinding shall be done by a suitable machine. Where grinding machine cannot be used hand grinding may be allowed when the first rubbing shall be with carborundum stone of coarse grade (No.60), second rubbing with medium grade (No.80) and final rubbing and polishing with fine grade (No.120). The surface shall be cleaned with water, dried and covered with oil free clean sawdust if directed by the
Engineer. The final polishing shall be postponed till before handing over if desired by the Engineer.

Just before handing over the surface shall be dusted with oxalic acid at the rate of 0.33 gm per sq.m, water sprinkled on to it and finished by buffing with felt or hessian bobs. The floor shall be cleaned with soft moist rag and dried. If desired by the Engineer, wax polish to be applied. However, all excess wax polish to be wiped off and the surface to be left glossy but not slippery.

1.17.2.3.1.4 Granolithic Finish:

Granolithic finish shall either be laid monolithically over base concrete or separately over hardened base concrete.

a. Thickness:

The finish shall be average 20 mm and minimum 12 mm thick, unless specified otherwise.

b. Mix:

The mix shall consist of 1 part cement : 1 part coarse sand : 2 parts coarse aggregate by volume. The coarse aggregate shall be very hard like granite and well graded between 6 mm and 2 mm. Minimum quantity of water to get workability shall be added.

c. Laying of monolithic topping:

The concrete base shall be laid as per specification 'Cement Concrete' and leveled up to the required grade. The forms shall remain sufficiently protruding to take the finish.

Within about 3 hours of laying the base while it is still fully 'green' the topping shall be laid evenly to proper thickness and grade. If considered necessary the surface of the base shall be roughened by wire brushing. Unless manual operation is permitted by the Engineer, mechanical vibrators of suitable design shall be used to press the topping firmly and work vigorously and quickly to secure full bond with concrete base.

The laitance brought to the surface during compression shall be removed carefully without disturbing the stone chips. The surface shall then be lightly trowelled to remove all marks. When sufficiently set, hard trowelling shall be done to secure a smooth surface without disturbing the stone chips.

For large areas the laying shall be in panels of maximum 25 sq.m area. The panels shall be laid in chequered board pattern.
d. Laying of topping separately on hardened base:

The base concrete shall be prepared as stated in clause 2.17.2.3 and a slurry of neat cement applied just prior to laying the granolithic concrete mix (1:1:2). The method of compaction etc. shall be same as for monolithic topping.

e. Curing: Immediately after laying, the finish shall be protected against rapid drying. As soon as the surface had hardened sufficiently, it shall be kept continuously moist for at least 10 days by means of wet gunny bags or pounding of water on the surface. The floor shall not be exposed to heavy traffic during this period.

f. Grinding:

If grinding is specified, it shall start only after the finish has fully set. Clause 2.17.2.3.1.2(c) shall be followed. However, the ultimate polish required shall be decided upon by the Engineer.

g. Finishing:

Where specified, sodium silicate or magnesium or zinc silicofluoride treatment shall be done. The number of coats to be applied shall be as specified in the schedule of items. The concentration and method of application of the solutions shall be as specified in IS:5491. 1.17.2.3.1.5 Patent Stone:

It shall consist of an underbed and a topping laid on an already laid and matured concrete base.

a. Thickness:

The patent stone finish shall have thickness as stipulated under Clause 2.17.2.3.1.2(a) except that the topping shall be 6 mm thick.

b. Mix:

i. Underbed:

The mix shall be as stipulated under Clause 2.17.2.3.1.3(b)

ii. Topping:

The mix for the topping shall consist of 1 part cement and 1 part fine sand by volume.

c. Laying:

The patent stone finish, including the underbed shall be laid in alternate bays or in chequered board pattern. No panel shall be cast in contact with another already laid till the contraction of the latter has already taken place.

The maximum area of each panel shall be 3 sq.m of which no side shall be more than 2 M long.
A cement grout shall be applied and worked into the surface to receive the finish, the underbed then laid, compacted and levelled to proper grade with a screed or float. The topping shall be applied evenly on the underbed while it is not fully set but firm enough and rolled and pressed to get full bond. The topping shall be trowelled to a dense finish to the satisfaction of the Engineer. All trowel marks shall be mopped out with a soft cloth to give a clean smooth surface.

After the surface is sufficiently set, the finished floor shall be kept moist for 7 days for curing. If desired the finish shall be polished as directed by the Engineer.

1.17.2.3.1.6 Metallic Hardener like 'Ironite' finish:

This will consist of a topping (incorporating iron particles) to bond with concrete base while the latter is 'green'.

a. Thickness:

Unless otherwise specified the metallic hardened finish shall be of 12 mm depth.

b. Material:

The hardening compound shall be uniformly graded iron particles, free from non-ferrous metal impurities, oil, grease, sand, soluble alkaline compounds or other injurious materials. When desired by the engineer, actual samples shall be tested.

c. Mix:

Proportion of the metallic hardener shall be specified or as indicated by the manufacturer. However, in absence of any such direction 1 part metallic hardener shall be mixed dry with 4 parts cement, by weight. To this mixture 6 mm nominal size stone chips shall be added in proportion of 1 part cement (mixed with hardener) to 2 parts of stone chips by volume and uniformly mixed. Minimum quantity of water shall be added to make it workable.

d. Laying:

The concrete floor shall be laid as per specification 'Cement Concrete' and leveled up to the required grade. The forms, if any shall remain sufficiently projecting to take the finish. The surface shall be roughened by wire brush as soon as possible.

The finish shall be laid while the concrete underbed is still very 'green' within about 4 hours of laying of the latter. The finish shall be of uniform thickness and even dense surface without trowel marks, pin holes etc. This topping
layer shall be pressed firmly and worked vigorously and quickly to secure full bond with the concrete base. Just when the initial set starts the surface shall be finished smoothened with steel trowel. The finished floor shall be cured for 7 days by keeping it wet.

1.17.2.3.1.7 Mastic Asphalt Finish:

This is a one layer treatment on concrete or brick base.

a. Thickness:

The thickness shall be as specified in the drawing.

b. Materials:

Bitumen shall be industrial bitumen of the grades 90/15 and 75/15 conforming to IS:702.

Mineral filler shall be dry lime stone dust passing through 75 micron IS Sieve.

Fine aggregate shall be crushed and graded natural lime stone or other hardrock.

Coarse aggregate shall be crushed siliceous stone or other approved aggregate. 6 mm stone chips shall be used for finish upto 20 mm thick and 10 mm chips for thicker finish.

c. Composition:

Bitumen mastic shall conform to IS: 1195 and shall be either brought to site in blocks weighing about 25 Kg or prepared at site. If brought in blocks, these shall be re-melted in mechanically agitated mastic cookers and coarse aggregate, preferably pre-heated, fed in successive portions until the complete change is thoroughly incorporated. At no stage during the re-melting and mixing process, shall the temperature exceed 205°C.

d. Laying:

The hot mastic shall be laid on dry base surface cleaned thoroughly by wire brushing and sweeping. The mastic shall be levelled and when cooled to some extent shall be finished with a wooden float with addition of small quantity of fine sand if required. No load shall be allowed till the finish has cooled to normal temperature.

The mastic shall be laid in suitable panels of about 15 sq.m in area each formed by formers. Succeeding panels shall be laid overlapping the finished panel so as to melt its edges and form a continuous finish without joint.
1.17.2.3.1 Chemical Resistant in Situ Finish:

Chemical resistant in situ finish shall be as per approved drawings. About its performance the Engineer shall have to be fully satisfied by test results and examination of similar treatment already in existence. The contractor shall get it done by a specialised manufacturer, get guarantee of performance from the organisation and pass it on to the owner in addition to his own guarantee.

1.17.2.3.2 Tiled Finish:

These shall include finish tiles, stone slabs and similar manufactured or natural items over already laid and matured base of concrete or masonry by means of an underbed or an adhesive layer.

1.17.2.3.2.1 Terrazzo Tile Finish:

The finish will consist of manufactured terrazzo tile and an underbed.

a. Thickness:

The total thickness including the underbed shall be minimum 40 mm for floors and 30 mm for walls unless otherwise specified.

The skirting, dado and similar vertical surfaces shall project out 6 mm uniformly from the adjacent plaster or other wall finished. The necessary cutting into the surface receiving the tiled finish, to accommodate the specified thickness shall be done.

b. Tiles: Terrazzo:

The tiles shall, unless specifically permitted in special cases, be machine made under quality control in a shop. The tiles shall be pressed hydraulically to a minimum of 140 Kg per sq.cm.

Each tile shall bear on back permanent and legible trade mark of the manufacturer. All angles of the tiles shall be right angles, all arises sharp and true, colour and texture of the wearing face uniform throughout. Maximum tolerance allowed in length and breadth shall be ± 1 mm and the thickness ± 3 mm. Face of the tile shall be plain, free from pin holes and other blemishes.

The tiles shall be composed of a backing and topping. The topping shall be of uniform thickness not less than 10 mm. The total thickness including the topping shall be as specified but not less than 20 mm in any case.

The backing shall be composed of 1 part ordinary grey cement and 3 parts of stone chips by weight mixed with water.

The topping shall be as specified under Clause 1.17.2.3.1.3 (b).
The tile shall be cured at the shop for at least 14 days before delivery to the site. First grinding shall be given to the tiles at the shop before delivery. Tiles shall be packed properly to prevent damage during transit and storage. The tiles must be stored carefully to prevent staining by damp, rust, oil and grease or other chemicals.

Tiles made in each batch shall be kept and used separately so that colour of each area of the floor may remain uniform.

The manufacturer shall supply along with the tiles the grout mix containing cement and pigment in exact proportions as used in topping of the tiles. The containers for the grout mix shall be suitably marked to relate it to the particular type and batch of tiles.

c. Mix - Underbed:

The underbed for floor and similar horizontal surface shall be 1 part lime putty : 1 part surkhi : 2 parts coarse sand by weight mixed with sufficient water to form a stiff workable mass. For skirting and dado and all vertical surfaces it shall be about 10 mm thick and composed of 1 part cement and 3 parts coarse sand by weight.

d. Laying:

The underbed mortar shall be evenly spread and brought to proper grade and consolidated to a smooth surface. The surface shall be roughened for better bond. Before the underbed had time to set and while it is still fairly moist but firm, cement shall be hand dusted over it or a cement slurry applied and the tiles shall immediately be placed upon and firmly pressed by wooden mallet on to the underbed until it achieves the desired level. The tiles shall be kept soaked for about 10 minutes just before laying. The joints between tiles shall be as close as possible and not more than 1.5 mm wide.

Special care shall be taken to check the level of the surface and the lines of the joints frequently so that they are perfect.

When tiles are required to be cut to match the dimensions these shall be sawn and edges rubbed smooth. The location of cut tiles shall be planned in advance and approval of the Engineer taken.

At the junction of horizontal surface with vertical surface the tiles on the former shall enter at least 12 mm under the latter.

After fixing, the floor shall be kept moist and allowed to nature undisturbed for 7 days. Heavy traffic shall not be allowed.

If desired dividing strips as specified under Clause 1.17.2.3.1.3(c) may be
used for dividing the work into suitable panels.

e. Grinding and Polishing:

Procedure shall be same as Clause 1.17.2.3.1.3(e). Only grinding shall not commence earlier than 14 days after laying of tiles.

1.17.2.3.2.2 Chequered Tile finish:

The finish shall consist of manufactured grey or coloured cement tiles of terrazzo tiles with chequered face and an underbed laid over concrete or brick surface.

a. Thickness:

Thickness shall be same as in Clause 1.17.2.3.2.1(a).

b. Chequered Tiles:

The tiles shall have chequers not less than 2.5 cm c/c and not more than 5 cm c/c. Depth of grooves shall be not less than 3 mm. The grooves shall be uniform and straight. The tiles shall conform to Clause 1.17.2.3.2.1(b) except that these may have the topping in terrazzo or plain grey cement or colour pigment added to cement as specified.

c. Underbed: As per Clause 1.17.2.3.2.1(c).

d. Laying: As per Clause 1.17.2.3.2.1(d).

e. Grinding and Polishing:

As per Clause 1.17.2.3.2.1(e) except that the tiles shall be ground and polished by hand after laying taking special care in polishing the grooves and uniformly.

1.17.2.3.2.3 Glazed Tile Finish:

This finish shall be composed of glazed earthen coarse tiles with and under-bed laid over concrete or masonry base.

a. Thickness:

The total thickness shall be between 20 mm and 25 mm including the under-bed.

The tile finish on vertical surface shall project out 6 mm uniformly from the adjacent plaster or other wall finishes. The necessary cutting into the surface receiving the finish, to accommodate the specified thickness shall be done.
b. Glazed Tiles:

The tiles shall be of earthenware, covered with glaze, white or coloured, plain or with designs, of 150 mm x 150 mm nominal sizes or any other approved sizes and 10 mm thick unless otherwise specified. The tolerance shall be ± 1.5 mm for length and breadth and ± 0.5 mm for thickness. Specials like internal and external angles, beads, covers, cornices, corner pieces etc. shall match. The top surface of the tiles shall be glazed with a gloss or matt unfading stable finish as desired by the Engineer. The tiles shall be flat and true to shape. The colour shall be uniform and fractured section shall be fine grained in textures dense and homogenous. The tiles shall be strong and free from flaws like cracks, chips, craze, specks, crawling etc. and other imperfections. The edges and the underside of the tiles shall be completely free from glaze and the underside shall have ribs or indentations for better anchorage with the fixing mortar.

The coloured tiles, when supplied, shall preferably come from one batch to avoid difference in colour.

c. Mix: Underbed: The mix for the underbed shall consist of 1 part cement and 3 parts coarse sand by weight mixed with sufficient water or any other mix if specified.

d. Laying: Same as Clause 1.17.2.3.2.1(d).

e. Finishing: The joints shall be cleaned and flush pointed with white cement and cured for 7 days by keeping it wet. The surface shall be cleaned with soap or suitable detergent, washed fully and wiped with soft cloth to prevent scratching before handing over.

1.17.2.3.2.4 Terrazzo Finish (Mosaic etc.):

This finish consists of manufactured vitreous, glass, ceramic or similar hard small pieces set in an underbed over a concrete or masonry surface, already laid.

a. Thickness: The total thickness including the underbed shall be between 16 mm and 25 mm.

b. Terrazzo Finish: These shall usually be 6 mm thick and shall have piece of ceramic vitreous china, tinted glass or similar hard wearing, strong and durable material in desired shapes and sizes and patterns.

The supply shall come in the desired pattern in full or in sections convenient for handling, stuck to pieces of strong thick paper on the surface to be exposed. The gum used for this purpose must be water soluble and non-staining. The sections shall be properly marked to avoid mistakes and master drawing shall be available at the site for guidance.
c. Mix : Underbed :Same as Clause 1.17.2.3.2.3(c).

d. Laying : The specification for laying if given by the manufacturer of the item shall be followed provided it is approved by the Engineer. Otherwise Clause 1.17.2.3.2.3 (d) shall generally be followed. However, instead of grey cement the slurry shall be made with white cement to fix the panels. The paper mounted patterns in sections shall be carefully placed and pressed in position true to lines and levels. Earliest possible the paper shall be peeled off and surface examined and cleaned, joints flush pointed with white cement and cured for 7 days by keeping it wet.

1.17.2.3.2.5 Chemical Resistant Tiles Finish : This shall include all varieties of special tiles used for specific chemical resistance function and an underbed over already laid concrete or masonry.

a. The chemical resistant tiles as per drawings shall be of the best indigenous manufacture unless otherwise specified and shall be resistant to the chemicals described in the drawings. The tiles shall have straight edges, uniform thickness, plain surface, uniform non-fading colour and texture.

Glazed tiles if permitted to act as chemical resistant finish shall be considered under Clause 1.17.2.3.2.3.

Usually the chemical resistant tiles shall not absorb water more than 2% by weight. The tiles shall have at least compressive strength of 700 Kg/cm2. The surface shall be abrasion resistant and durable.

b. Laying :

The mortar used for setting or for underbed shall be durable and strong. The grout which shall be to the full depth of tile, shall have equal chemical resistant properties. Joints shall be pointed if so desired. The setting and fixing shall be according to the manufacturer's specification approved by the Engineer.

1.17.2.3.2.6. Rubber, Vinyl or Vinyl asbestos Tiles Finish :

This shall include various types of tiles manufactured from rubber, vinyl etc. set with a sticker on concrete or masonry base. An underbed may be required to secure desirable surface and grade.

a. Thickness :

The thickness of the tiles shall be mentioned in drawings or elsewhere.

b. Tiles :

Unless otherwise desired the tiles shall be square of approved dimensions.
The tolerance in dimensions shall be $\pm 1.5$ mm.

The face of the tiles shall be free from porosity, blisters, cracks, embedded foreign matters or other physical defects which affect appearance or service ability. All edges shall be cut true and square. The colour shall be non-fading and uniform in appearance, insoluble in water and resistant to alkalis, cleaning agents and usual floor polishes.

Each tile shall be marked on the back legibly and indelibly with manufacturer's trade mark, the thickness, sizes, batch number and date of manufacture.

Tiles shall be delivered securely packed and stored in clean, dry, well ventilated place at a temperature near about to that the tiles shall be called upon to stand ultimately.

Adhesive to be used for sticking the tiles shall be approved by the tile manufacturer. The adhesive shall have a short drying time and long life in addition to toughness.

c. Mix : Underbed :

The underbed where required to make up the specified thickness or to give the required grade or to get the right type of surface shall be composed of 1 part lime putty : 1 part cement : 4 parts coarse sand mixed with just sufficient water to make it workable.

d. Laying :

The tiles shall be kept in the room to be tiled for at least 24 hours to bring them to the same temperature as the room. For air conditioned space, the air-conditioning shall be completed before tiling is taken up.

The surface to receive this finish shall be firm, even texture but not too smooth, without undulations and other deficiencies. If an underbed is laid the same be cured for at least 7 days by keeping it moist and then fully dried.

The surface shall be thoroughly cleaned. All loose dust particles shall be removed. Oil and grease if any shall be completely cleared by use of detergent.

The adhesive shall be applied to fully dry surface in desired thickness uniformly. The adhesive shall also be applied to the backs and edges of the tiles and allowed to surface dry. The tiles shall be placed neatly on the surface exactly to the approved pattern and set with a suitable tool.
If the edges tend to curl up, weights to be used to keep the edges down. Special care shall be taken to avoid formation of air pockets under the tiles. The joints shall be very fine. Any adhesive squeezed out through the joints shall be removed immediately.

e. Finishing:

If any adhesive mark is there on the surface a soft cloth soaked insolvent shall be used to wipe it off. The surface shall be cleaned with soft soap, dried and polished with an approved type of polish just before handing over.

1.17.2.3.2.7 Stone Slab Finish: Marble Stone and similar Fine Grained Stone:

This shall include natural stone slabs of regular shape and dimensions and capable of taking good polish and an underbed over concrete or masonry surface.

a. Thickness:

The underbed shall be minimum 12 mm and average 20 mm thick. The slabs may be 25 mm, 30 mm or 40 mm thick as specified.

b. Stone Slab:

The stone slabs shall be made from selected stock which are hard, sound, homogeneous and dense in texture and free from flaws. Angles and edges shall be true, square, free from chipping and surface shall be plane. The slabs shall preferably be machine cut to the required dimensions. Tolerance of $\pm$ 5 mm in dimensions and $\pm$ 2 mm in thickness will be allowed. Unless specified the slabs shall be minimum 300 mm x 300 mm.

The stone slab shall come from specific regions and in specified quality with top surface fine chisel dressed. All sides shall also be fine chisel dressed to the full depth to allow finest possible joints.

The slabs shall be delivered to the site well protected against damages and stored in dry place under cover.

c. Mix: Underbed: Same as Clause 1.17.2.3.2.1 (c)

d. Laying: The sides and top surface of the slabs shall be machine rubbed or table rubbed with coarse sand and washed clean before laying.

The underbed mortar shall be evenly spread and brought to proper level on the area under each slab. The slab shall be laid over the underbed, pressed and tapped down with wooden mallet to the proper level.
The slab shall then be lifted and the underbed corrected as necessary and allowed to stiffen a little. Next, a quick cement slurry shall be spread over the surface. The edges of the slab shall be buttered with slurry of cement, grey/white/mixed with pigment matching the colour of the stone slabs. The slab shall be gently laid and tapped with wooden mallet to bed properly to a very fine joint and to the required level. All surplus cement slurry shall be removed and the surface mopped clean with wet soft cloth. The laid finish shall be cured for 7 days by keeping it wet.

e. Polishing, Finishing:
Fine chiselling shall be done to remove the slight undulations that usually exist at the joints. The polishing and finishing shall be done as specified under Clause 1.17.2.3.2.1(e). However, the joints shall be so fine in the case of stone slabs that grouting shall not be called for.

1.17.2.3.2.8 Stone Slab Finish: Sand Stone & similar Coarse Grained Stone Finish:

Generally Clause 1.17.2.3.2.7 shall be followed except that the workmanship and finish shall not be fine as which are explained hereunder.

The slabs shall be rough chiselled or fine chiselled as specified. Tolerance may be allowed upto $\pm 6$ mm for rough finish, but no sharp unevenness shall be allowed. For fine chiselling the unevenness shall be limited to $\pm 2$ mm. The sides shall be chisel dressed at least to half slab depth so that the maximum deviation from straight line shall be within 25 mm. Beyond this depth the edge may be slightly splayed.

The joint thickness shall be kept limited to 5 mm in case of rough finish and 3 mm in case of fine finish unless wider joints are specified. The joints shall be grouted with white or coloured cement.
1.17.3 Acceptance Criteria:

The finish shall be checked specially for:

a. Level, slope, plumb as the case may be.
b. Pattern and symmetry.
c. Alignment of joints, dividing strips etc.
d. Colour, texture.
e. Surface finish.
f. Thickness of joints.
g. Details of edges, junction etc.
h. Performance.
i. Precautions specified for durability.

Passing of all necessary relevant Quality Control Tests.

1.17.4 I.S. Codes:

All latest relevant IS codes/CPWD/NBO/International Standards shall be followed. A few of them are mentioned below:

- IS: 777 - Glazed earthenware tiles.
- IS: 1237 - Cement concrete flooring tiles.

1.18 TECHNICAL SPECIFICATION FOR METAL DOORS, WINDOWS, VENTILATORS, LOUVERS ETC.

1.18.1 Scope:

The work in general shall consist of supplying and/or erecting and installing of all metal doors, windows, ventilators, louvers, glazed partitions etc. as shown on drawings with all materials complete excluding supply of glass and glazing.
1.18.2 Installation: 1.18.2.1 Materials: Steel sections used for fabrication of doors, windows etc. shall be standard rolled steel sections specified in IS:1038 and IS:1361 as specified in drawing. Steel sheets for frames, shutters, louvers blades etc. shall be of gauge mentioned in this specification. Hardware and fixtures of the best quality from approved manufacturers shall only be used. The bidder shall specifically state the particular manufacturer's materials he proposes to use. All hardware and fixtures shall be able to withstand repeated use. Door closers shall conform to IS:3564 and shall be suitable for doors weighing 61-80 Kg. Unless otherwise stated. Each closer shall be guaranteed against manufacturing defect for one year and any defect found within this period shall be rectified or the closer replaced free of charge. Concealed door closers shall be either floor mounted or transom mounted, suitable for installation with metal doors. It shall conform to the performance requirements and endurance test stated in IS: 3564 (Appendix - A). The contractor shall submit samples of each type of hardware to the Engineer. The approved samples shall be retained by the Engineer for comparison of bulk supply. The mastic for caulking shall be of best quality from a manufacturer approved by the Engineer. In general, the mastic for fixing of metal frames shall be as per IS:1081 and/or as approved by the Engineer.

1.18.2.2 Fabrication:
1.18.2.2.1 Steel Doors, Windows, Ventilators, Louvers etc.: a. Door Frames: Frames shall be fabricated from 16G sheets. They shall be mortised, reinforced, drilled and tapped for hinges and lock and bolt strikes. Where necessary frames shall be reinforced for door closers. Welded construction with mitered corners shall be used. Rubber door silencers shall be furnished for the striking jamb. Loose 'T' masonry anchors shall be provided. Frames shall finish flush with floor and adjustable floor anchors shall be supplied. Frames shall be brought to site with floor ties/weather bars installed in place. b. Double Plate Flush Door Shutters: Door shutters shall be 45 mm thick, completely flush design and shall comprise of two outer sheets of 18 G steel sheets, rigidly connected and reinforced inside with continuous vertical 20 G stiffeners, spot welded in position at not more than 150 mm at centres.
Both edges of doors shall be joined and reinforced full height by steel channels placed immediately inside and welded to the door faces.

Top and bottom of doors shall be reinforced horizontally by steel channels running full width of door. Doors shall not have more than 2.5 mm clearance at jambs and head shall have proper bevel on lock stiles and rails to operate without binding and shall be reinforced at corners to prevent sagging or twisting, pairs or double doors shall have meeting stile edges beveled or rebated. Where shown on drawing, the doors shall be sound-deadened by filling the inside voids with mineral wool or other suitable approved materials. Door shall be mortised, reinforced, drilled and tapped in shop for hinges, locks and bolts. They shall also be reinforced for closers, push-plates and other surface hardwares where necessary. Any drilling and tapping required for surface hardware shall be done at site. Where shown in drawing, provision shall be made for fixing glazing, vision panels, louvers etc. Glazing mouldings shall be of 18 G steel of extruded aluminium section with profiles shown in drawing and suitable for fixing 6 mm glass. Louvere blades shall be 'V' or 'Z' shaped and made out of 16 G sheets.

c. Single Sheet Door Shutters:

Single sheet doors shall be made from best quality 18 G mild steel sheets and shall present a flush surface on the outside. The inside shall be stiffened with semi-tubular edge and central stiffening rail which shall convey the look of any other furniture. The frames shall be made from best quality 16G mild steel sheets.

Wherever required as shown on drawings, provisions for fixing glass panes, louvers etc. shall be made.

The manufacturing shall be done as specified in 2.18.2.2.1(b) 'Double Plate Flush Door Shutters'.

d. Sliding Doors:

Sliding doors shall be either double plate or single plate construction as required and made out of 18 G steel sheets with adequate stiffeners. The contractor shall specify the weight of the door in his shop drawing and submit the manufacturer's catalogue of the sliding gear he proposes to use.
Where shown on drawings, the contractor shall make provisions for openings in the door for monorail beams. Doors shall close positively to exclude rain water from seeping in. Sliding doors shall withstand specified wind loads without buckling or jamming. The door shall slide freely under all ambient conditions.

e. Steel Windows, Sashes, Ventilators etc.

These shall conform in all respects to IS:1038 and IS:1361 (latest editions) and as shown on drawings. The details as called for in the above codes shall be applicable for coupling, mullions, transoms, weather bars, pivot arrangements for ventilators etc.

All welds shall be dressed flush on all exposed and contact surfaces. Where composite unit openings are shown on drawings, the individual window units shall be jointed together with requisite transoms and mullions. All windows shall be outside glazed, fixed with putty or metal glazing beads.

1.18.2.3 Shop Coat or Paint:

The shop paint for steel doors, windows etc. shall be best lead or zinc chromate primer paint from approved manufacturer. All surfaces shall be thoroughly cleaned of rust, grease, loose mill scales etc. and given one coat of shop paint. Portions like mullions, transoms etc. which will be inaccessible after assembly of units shall be given an extra coat of paint before assembly. Where called for in the drawings, all steel doors, windows etc. shall be not dip galvanized to give a coating weight of 1.5 - 2 oz. per sq. ft. One coat zinc chromate primer coat shall then be applied as shop paint.

1.18.2.4 Handing and Storage of Fabricated Material:

All metal doors, windows etc. shall be packed and crated properly before despatch, to ensure that there will be no damage to the fabricated materials. Loading into wagons and trucks shall be done with all care to ensure safe arrival of materials at site in undamaged condition.

All metal doors, windows etc. shall be stored under cover in a way to prevent damage or distortion.

1.18.2.5 Assembly and Erection at Site:

In general, the fixing of steel doors, windows, ventilators, louvers etc. shall conform to IS:1081. The contractor shall assemble and install all steel doors, windows, sashes,
fixed metal louvers etc. including transoms and mullions for complete units in respective places keeping proper lines and levels and in approved workmanlike manner, to give trouble free and leak-proof installation. If required by the Engineer, the installation shall have to be carried out under the supervision of the manufacturer's staff. After installation of steel doors, windows etc., all abrasions to shop-coat paint shall be retouched and made good with the same quality of paint used in shop-coat. All coupling mullions, transoms, frames etc., in contact with adjacent steel and other members, shall be well bedded in mastic. The contractor shall bring to the site the mastic cement in original sealed containers of manufacturer and shall apply it as per the instruction.

Door shutters, partitions, hardware fixtures etc. shall be fixed only after major equipment have been installed in rooms.
Wherever required, nylon cords of approved quality shall be supplied along with pivoted sashes and shall be adequate length to terminate one metre from the floor. Loose ends of cords shall end in metal or plastic pull as approved by the Engineer.

1.18.3 Acceptance Criteria:
1.18.3.1 For Fabricated Items:

a. Overall dimensions shall be within ± 1.5 mm of the size.
b. Mullions, transoms etc. shall be in one length and permissible deviations from straightness shall be limited to ± 1.5 mm from the axis of the member. Door and window shutters shall operate without jamming. The clearance at head and jamb for door shutters shall not exceed 1.5 mm. For double leaf doors, the gap at the meeting styles shall not be more than 1.5 mm.
d. Door leaves shall be undercut where shown on drawings.
e. Doors, windows, frames etc. shall be on a true plane, free from warp or buckle.
f. All welds shall be dressed flush on exposed and contact surfaces.
g. Correctness of location and smoothness of operations of all shop in stalled hardware and fixtures.
h. Provision for hardwares and fixtures to be installed at site.
i. Glazing beads shall be cut with mitred corners.

j. Glazing clips, fixing devices etc. shall be supplied in adequate numbers.

k. Shop coats shall be properly supplied.

l. The work should pass all necessary relevant quality control tests.

1.18.3.2 For Installed Items:

a. Installations shall be at correct location, elevation and generally on a true vertical plane.

b. Fixing details shall be strictly as shown on drawings.

c. Assembly of composite units shall be strictly as per drawings with mastic caulking at transoms and mullions, gaskets, weather strips etc. complete.

d. All frames on external walls shall be mastic caulked to prevent leakage through joint between frames and masonry.

e. All openable sections shall operate smoothly without jamming.

f. Locking, fasteners etc. shall engage positively. Keys shall be non-interchangeable.

g. Cutting to concrete or masonry shall be made good and all abrasions to shop paint shall be touched up with paint of same quality as shop paint.

h. The work should pass all necessary relevant Quality Control Tests.

1.18.4 Information to be Submitted:

a. Before starting fabrication of all metal doors, windows, etc., the contractor shall submit detailed fabrication drawings to the Engineer for approval. The fabrication shall be started only after approval of drawings.

b. The contractor shall submit a programme of work to be done for the approval of the Engineer.

c. Before bulk supply, the contractor shall submit for the approval of the Engineer samples of all bought out items and samples of each type of fabricated item. The samples shall be retained by the Engineer for comparison of bulk supply.

1.18.5 I.S.Codes:

All latest relevant IS codes/CPWD/NBO/International Standards shall be followed. A few of them are mentioned below:

IS: 1038 - Steel doors, windows and ventilators.

IS: 1361 - Steel windows for industrial buildings.
1.19 TECHNICAL SPECIFICATION FOR GLASS AND GLAZING :

1.19.1 SCOPE :

The work in general shall consist of supplying and fixing all glass and glazing including all clips, putty, mastic cement etc., wherever required as shown on drawings and specifications.

1.19.2 INSTALLATION :

1.19.2.1 General :

The contractor shall supply and install all glass and glazing as required for various doors, windows, sashes, ventilators and fixed louvers, miscellaneous glazing and partitions, unless otherwise stated in the drawings or schedule. All glass shall be of superior quality from approved manufacturer like Hindustan Pilkinton or equivalent, having uniform refractive index and free from flaws, specks and bubbles. The glass shall be brought to site in the original packing from the manufacturer and cut to size at site. The cut edges shall be straight and free from chips, spalls or any other damages.

1.19.2.2 MATERIALS :

a. Glare reducing or heat absorbing glass shall be 'Calorex' of Hindustan Pilkinton or approved equivalent and special care shall be taken to grind smooth and round off the edges before fixing.

b. Clear glass shall be flat drawn sheet glass and shall be at least 4 mm thick. Sheet glass for doors shall be minimum 5.5 mm thick.

c. Wired glass shall be thick rolled glass with centrally embedded 24 G wire mesh or georgian type. This may be clear or coloured glass, as shown drawings or schedules.

d. Obscure glass shall have a cast surface on one side.

e. Coloured and figured glass shall be as per approved sample.

f. In general, the putty shall conform to IS : 419 and be of best quality from approved manufacturer. It shall be brought to site in the manufacturer's original packing. Quick setting putty shall be used for windows and sashes except when glare reducing glass is used where it shall be of non-setting type.
g. Neoprene gaskets with snap-fit glazing beads shall be fixed as per manufacturer's instructions and shall sit snugly against glass to give a leakproof installation.

1.19.2.3 GLAZING, SETTING AND FINISH :

All glazing clips, bolts, nuts, putty, mastic cement etc. as required shall be supplied by the contractor.

All glass shall be thoroughly cleaned before putting in position. Each glass pane shall be held in place by special glazing clips of approved type. As specified in relevant IS codes, four glazing clips shall be provided per glass panel, except for large panes where six or more clips shall be used as per Engineer's instructions. All holes that may be necessary for holding the clips, glazing beads and all other attachments shall be drilled by the contractor.

Glass panes shall be set without springing and shall be bedded in putty and back puttied, except where mouldings or gaskets are specified. Putty, mastic cement etc. shall be smoothly finished to a true even line. Obscure and figured glass shall be set with smooth side out.

After completion of glazing work, the contractor shall remove all dirt, stains, excess putty etc., clean the glass panes and leave the work in perfectly acceptable condition. All broken, cracked or damaged glass shall be replaced by new ones at the contractor's own cost.

1.19.3 ACCEPTANCE CRITERIA :

a) All installations shall be free from cracked, broken or damaged glass, edges of large panes of thicker glass and heat absorbing glass shall be inspected carefully for chipped, cracked or unground edges.

b) Glazing shall be carefully done to avoid direct contact with metal frames.

c) All glass shall be embedded in mastic or fixed by neoprene gaskets to give a leak-proof installation.

d) At completion, the panes shall be free from dirt, stains, excess putty etc. to the complete satisfaction of the Engineer.

 e) The work should pass all necessary relevant Quality Control Tests.

1.19.4 I.S. CODES :

All latest relevant IS codes/CPWD/NBO/International Standards shall be followed. A few of them are mentioned below :
1.20 TECHNICAL SPECIFICATION FOR ROLLING STEEL SHUTTERS/GRILLS:

1.20.1 Scope:

This specification covers the design, supply of materials, fabrications, delivery and erection of Rolling Shutter/Grills with motor drives and/or manual operation including all accessories as hereinafter specified. All electrical works will be as per Indian Electricity Rules.

1.20.2 Installation:

1.20.2.1 Components:

a) Slats of rolling shutters shall be made from tested bright cold rolled, annealed M.S. strips, not less than 0.9 mm thick for shutters up to 3.5 m wide and not less than 1.25 mm thick for shutters 3.5 m and above, machine rolled at 755 mm rolling centres, interlocking with each other. The profile will be such as to prevent excessive deflection under specified wind load.

b) Rolling grills shall be constructed out of 6 mm dia rods at 35 mm on centres running horizontally flexibly connected with vertical links spaced not more than 200 mm centres. Alternatively, rolling grills shall be made from perforated slats of approved design reinforced with 6 mm dia rods.

c) End locks shall be heavy type M.C.I./C.I. and shall be provided at each end of alternate slats unless specified otherwise in the schedule.

d) Bottom bars shall be finished with two angles not less than 6 mm thick for external shutters. A flexible contact weather strip shall be applied to make tight contact with the floor.

e) Guides shall be of such depth as to retain the shutter under a wind pressure of 150 Kg/Sq. m. or as specified in schedule.

f) Shaft shall be of steel pipe of sufficient size to carry the torsional load with a maximum deflection of 1/360th of span. Grease packed ball bearings or brushings shall be provided for smooth trouble free operation.

g) Hoods shall formed of not less than 20 gauge steel, suitably reinforced to prevent sag.
h) Locks shall be slide bolt and hasp or cylinder lock operable from one or both sides. Provision to securing hand chain with pad-lock, provision for removable handle for hand cranks etc. shall be made as described in schedule or as desired by the Engineer.

i) Power unit shall be suitable for 3 phase, 50 cycles, 400 volt A.C. power supply and shall be either floor or wall mounted unit. The motor shall be of sufficient capacity to move the shutter in either direction at a speed of 0.3 m per second. In addition to the gear motor each standard power unit shall include a magnetic brake, a reversing starter with built-in overload protection, a geared limit switch and one push-button station located inside the building unless otherwise stated in schedule or drawing.

It is desirable that the bottom bar of motor operated doors shall be provided with a sensitive edge, electrically connected to stop the travel of the door on meeting an obstruction.

j) Operating chains shall be of tested quality, heavily galvanised and with all ends rounded to assure smooth operation and hand protection.

k) Reduction gears shall be high strength grey cast iron machine moulded from machine cut patterns.

1.20.2.2 Manually Operated Shutters/Grills:
Manually operated shutters shall be easily operable by one person. The speed of operation shall be about 0.3 metres per second. In general, manually operated shutters shall be push-pull type for openings upto 9 Sq. m. in area. Larger shutters shall be either chain and gear operated or crank and gear operated. The crank handles shall be removable. All shutters shall be lockable from one or both sides as described in schedule or as desired by the Engineer.

1.20.2.3 Power Operated Shutters/Grills:
These shall be operable from a push-button station conveniently located beside the door or as shown on drawings. One emergency hand chain /crank operation shall also be provided for use in case of failure of the electrical system. Where called for in schedule, externally mounted shutters shall be operated by control mechanism located inside the building.

1.20.2.4 Shop Coat:
Shutters shall be painted with one coat of red lead or zinc chromate primer. Where specified, doors shall be galvanised subsequently painted one coat of zinc chromate for adhesion of field coat.
1.20.3 ACCEPTANCE CRITERIA :
1.20.3.1 Shop Inspection :
   After completing the manufacture of the different components of the rolling shutter, an arrangement for shop inspection by the Engineer shall be made to check the conformity with approved shop drawings. The work should pass all necessary relevant Quality Control Tests.

1.20.3.2 Field Inspection :
   After installing the shutters, the contractor shall test the performance of the shutter in the presence of the Engineer. The doors shall be smoothly operable under all ambient conditions. All control and locking devices shall give fault-free performance. The work should pass all necessary relevant Quality Control Tests.

1.20.3.3 Guarantee :
   The contractor shall give one year's guarantee for the successful operation of the shutters. This shall be supported by separate and unilateral guarantee from the manufacturer of the shutters.

1.20.4 I.S. Code :
   All latest relevant IS codes/CPWD/NBO/International Standards shall be followed. A few of them are mentioned below :

   I.S. : 6248 (latest) - Metal rolling shutters and rolling grills.

1.21 TECHNICAL SPECIFICATION FOR SUSPENDED CEILING :

1.21.1 SCOPE :
   The work under this section shall include the supply and installation of suspended ceiling using pre-laminated particle boards or any other material as approved by the Engineer together with the suspension system as shown on drawing or specified elsewhere with all materials labour and equipment. The work shall also include providing openings in the ceiling for lighting, air-conditioning, diffusers etc., as shown on drawings or instructed by the Engineer.
1.21.2 INSTALLATION:

1.21.2.1 Suspension System:

1.21.2.1.1 General:

Suspension system shall consist of the grid supporting the ceiling panels, intermediate runner supports for the grid and hangers, wall angles etc. required to suspend the grid or the runners from structural walls, slabs and beams or trusses.

All members of the suspension system shall be of sufficient strength and rigidity to carry the ceiling boards or other materials in a true level and plane without exceeding a deflection of 1/360th of their span. All joints in ceiling panels shall run straight and cross joint shall be at perfect right angles. Angle moulds, where shown on drawings, shall be securely fixed to walls. All drillings of structural concrete or welding to steel for installation of the suspension system shall be included in the scope. All M.S. sections used for supports etc. shall be given one coat of synthetic enamel paint over a coat of red lead primer. All wood supports, if any, shall be painted with two coats of 'Solignum' or other approved wood preservatives before erection.

1.21.2.1.2 Metal Grid Suspension System:

Aluminium grid ceiling system shall be "Beadlok" as manufactured by W.A Boardsell and Co. Pvt. Ltd. or approved equivalent. Steel grid ceiling system shall be jolly-snap grid as manufactured by Anil Hardboards Ltd. or approved equivalent.

Angle cleats or other suitable fixing device shall be fixed to the structural beam or slab above for fixing of hangers. Main runners shall be hung by M.S. flats, angles or 12G or heavier galvanised tie wire hangers at maximum 1.2 M centres. Extra hangers shall be provided at light fixtures that are supported from the ceiling system. The spacing of main and cross runners shall be as shown on drawings.

The cross-tees shall intersect main runners in pattern shown on drawing and positively locked together with intersection clips. All perimeter areas shall have angle mouldings fixed to vertical wall surfaces and end tees shall rest on the moulding, unless otherwise shown on drawing.
1.21.2.1.3 Timber Grid Suspension System:

Such suspension system shall be used only at the places where so instructed by the Engineer, otherwise the suspension system at 2.21.2.1.2 above shall be used at all the places. The suspension system shall consist of 50 mm x 50 mm pretreated teakwood batton grid suspended in the same manner described for metal grid system. The spacing of timber battens shall be as shown on drawing. Extra battens shall be provided where necessary for openings for light fixtures, A.C grills etc.

1.21.2.2 Ceiling Panels:

1.21.2.2.1 Materials and installation:

Ceiling panels shall be best quality material in thickness and properties as approved by the Engineer. The contractor shall submit test certificates to the Engineer for approval before bulk supply. The ceiling panels shall be of 12 mm thick phenol formaldehyde resin bonded both side prelaminated particle boards of approved quality and brand conforming to relevant IS Codes. The size of panels shall be of 600 mm x 600 mm x 300 mm and of required size at the ends of wall, near cutouts/slits etc. consisting of frame work of anodised aluminium Tee sections with required size panels. The main load bearing Tee runner shall be of size 36.5 mm x 23.5 mm x 1.5 mm thick bulb head suspended from roof by 6 mm dia cold drawn galvanised M.S. bar hanged from the ceiling by means of galvanised M.S. dash-fastners, M.s. Galvanised ceiling cleat and M.S. galvanised holding cleat of 3 mm thick at a distance of not more than 600 mm both ways, bottom 75 mm length of suspension rod threaded and fixed to the main runner with double nut arrangement for level adjustment. Anodised aluminium cross tee of size 23.5 mm x 23.5 mm x 1.5 mm punched on both sides (wherever required) fixed and interlocked in the slot of main tee in true alignments as per grid arrangement and direction of the Engineer-in-charge. The false ceiling frame work shall be suitably adjusted to make provision for fixing electrical light fittings and return air grills, ducts etc. The frame work along the walls shall be fixed by means of anodised aluminium angles of size 25 mm x 25 mm x 1.5 mm with rawl plugs and self-tapping steel screws, the board of each panels shall be held at required height upto 3.5 m above original floor in true level by means of spring clips/cotter pins at required intervals as per direction of the Engineer-in-charge. The rate shall include the cost of all materials and operations including mending good the damages to the ceiling, walls etc.
Nothing extra shall be paid for change of grid pattern at the time of execution, cutouts/slits for electrical fittings and A/C requirements etc. Necessary anodised aluminium fittings shall be provided by the side of cutouts/slits as per direction of the Engineer at no extra cost, no deduction shall be made for any cutouts/slits/openings etc. for an area of up to 0.3 sq.m or/and width up to 0.30 m for a long slit.

1.21.3 ACCEPTANCE CRITERIA:

Finished ceiling shall be at the correct place and present a pleasing and uniform appearance, free from sags, warps, disfigured or damaged boards. Joints, exposed grids etc. shall be in true lines and symmetrically placed in manner as shown on approved drawings. Cutouts for light fixtures, diffusers etc. shall be of exact dimensions and in exact locations. The entire work should pass successfully all necessary and relevant quality control tests.

1.21.4 I.S.Codes:

All latest relevant IS codes/CPWD/NBO/International Standards shall be followed including the following:

IS: 2441 - Code of practice for fixing ceiling coverings and all other relevant IS Codes.

1.22 TECHNICAL SPECIFICATION FOR ROOF WATER PROOFING, INSULATION AND ALLIED WORKS:

1.22.1 SCOPE:

This specification covers furnishing, installation, repairing, finishing, curing, testing, protection, maintenance till handling over of roof water-proofing, insulation and allied works for buildings and at locations covered under the scope of the contract.

1.22.2 Installation:

1.22.2.1 Grading Underbed:

The surface to receive the underbed shall be roughened and thoroughly cleaned with wire brush and water. The joints in case of pre-cast planks used for roofing shall be thoroughly filled in with 1:2 cement mortar using 'Impermo' or approved water-proofing compound. Oil patches, if any, shall be removed with detergent. The surface shall be soaked with water and all excess water removed just before laying of the underbed.
The underbed shall not be laid under direct hot sun and shall be kept in shade immediately after laying so as to avoid quick loss of water from the mix and separation from the roof surface. The underbed shall be cured under water for at least 7 days.

The underbed shall be laid to provide an ultimate run-off gradient not less than 1 to 120 and as directed by the Engineer. Upto an average thickness of 25 mm the underbed shall usually be composed of cement and sand plaster. For higher thickness the underbed shall be made with cement concrete.

The underbed shall be finished to receive the water-proofing treatment direct or insulation as the case may be.

1.22.2.1.1 The grading plaster shall be average 25 mm thick maximum. It shall consist of cement and coarse sand in the ratio 1:4 nominal by volume. The sand and cement shall be thoroughly mixed dry and then water added. Each batch of mix shall be consumed before the initial set starts. The plaster shall be fully compacted to the desired grade in continuous operation. The surface shall be even and reasonably smooth.

1.22.2.1.2 Concrete:
The concrete shall be used where the sub-grade is more than average 25 mm thick. It shall consist of cement concrete 1:2:4 nominal mix by volume with 12 mm down stone chips and coarse sand. The aggregate shall be mixed dry and minimum quantity of water shall be added to make the mix workable.

The mix shall be laid to proper grade, fully consolidated and surface shall be smooth and even.

1.22.2.2 Water-proofing with felt lining:
a. Bitumen felt type-3, grade-I water proofing (4 layers finished with asphalt/crushed stone chips and/or gravel.

(i) A layer of special roofing asphalt grade 80/100 conforming to IS : 702 @ 1.45 Kg per sq.m.

(ii) A layers of bitumen felt Hessian based self finished felt type-3, grade-I, of approved make.

(iii) A layer of special roofing asphalt grade 80/100 conforming to IS : 702 @ 1.45 Kg per sq.m.

(iv) A layer of crushed pea size stone chips and/or gravel.
1.22.2.3 Water-proofing Water Tanks etc. by using cement water proofing compound:

The cement water proofing compound shall conform to IS:2645-1975 and shall be approved by the Engineer. It shall be added to the cement and content of concrete or mortar @ 3% by weight or as per manufacturer's specifications.

The water proofing treatment with the use of cement water proofing compound shall be done as follows:

a) By adding water proofing compound to concrete mix while concreting:
   i) If required, during concreting adequate dewatering measures shall be adopted by the contractor to keep the excavations basements dry so that normal setting variety of cement water-proofing compound can be used.
   ii) If for any reason concreting is to be carried out in or under water, the quick setting variety of the waterproofing compound shall be used.
   iii) Only sufficient quantity of waterproofing compound shall be mixed as can be used within one hour for normal setting variety of waterproofing compound.

b) Plastering the outside of the RCC water tanks with 12 mm thick cement plaster 1:3 (1cement : 3 coarse sand) with an admixture of waterproofing compound at 3% by weight of cement or as per manufacturer's specifications.

c) Plastering the inside of the RCC Water Tanks etc. 12 mm thick overall in cement mortar 1:3 (1cement : 3coarse sand). In all the waterproofing compound shall be added @ 3% by weight of cement or as per manufacturer's specifications.

d) Laying 40 mm thick cement concrete floor over internal floors of RCC water tanks with an admixture of cement water-proofing compound as per manufacturer's specifications.

e) Guarantee: The contractor through the specialised agency and sub contractor shall give a guarantee against any leakage for ten years. Any leakage or defects during this period shall be made good by the contractor at his own cost in a manner to be decided by the Engineer to their entire satisfaction.

f) Measurement: Waterproofing compound shall be measured and paid separately by weight. The other items shall be measured under relevant items or schedule of quantities.
1.22.3 ACCEPTANCE CRITERIA:
The surface level shall be such as to allow quick draining of water without leaving any pool anywhere. The finishing course shall be fully secured and shall have an even density. There shall not be any bubble formation or crushed or squeezed insulation on underbed.

The work should pass all necessary and relevant Quality Control Tests. The Contractor shall give a guarantee in writing for all works executed under this specification supplemented by a separate and unilateral guarantee from the specialised agency for the roof water-proofing treatment work. The guarantee shall be for materials and workmanship for five 5 years. The mode of execution of the guarantee shall be such which is acceptable to the owner.

1.22.4 I.S.Code:
All latest relevant IS codes/CPWD/NBO/International Standards shall be followed. A few of them are mentioned below:

IS: 73 (latest) - Paving Bitumen
IS: 702 (latest) - Industrial Bitumen
IS: 1203 (latest) - Methods of testing tar and Bitumen
IS: 1322 (latest) - Bitumen felts for water-proofing and damp proofing
IS: 1346 (latest) - Code of practice for water-proofing of roofs with Bitumen felts.
1.23 TECHNICAL SPECIFICATION FOR WATER SUPPLY :

1.23.1 SCOPE :

This section includes supply of all materials, labour and incidentals for water supply system.

1.23.1.1 Materials :

All materials, fittings, fixtures and appliances shall be of the best quality conforming to relevant Indian Standards and shall be procured from approved manufacturers. Unless specifically allowed by the Engineer, the Contractor shall submit samples of fittings and fixtures which will be retained by him for comparison when bulk supplies are received at the site. Ultimate choice of type, model and manufacture lies completely with the Engineer. It shall be the responsibility of the Contractor to procure the materials selected by the Engineer. Hence orders are to be placed with the manufacturers in time, so that the materials are available at the site well ahead of their requirement. The materials brought to the site, shall be stored in a separate secured enclosure away from the building materials. Pipe threaded sockets, brass and other expensive items shall be kept under lock and key. Fragile items shall be checked thoroughly when received at the site and items found damaged shall not be retained at the site.

1.23.1.2 Pipes and Pipe fittings :

Under scope of this specification, pipes and pipe fittings may be of any or a combination of the following types :

a) Cast Iron.
b) Steel - lined, coated with bituminous composition, out coated with cement concrete or mortar or galvanised.
c) Reinforced concrete.
d) Pre-stressed concrete.
e) Asbestos cement.
f) Lead (Not to be used for potable water).
g) PVC.
h) Copper.
i) Brass.
j) Wrought iron.

1.23.1.3 Water Reservoirs :

Water reservoirs like pressed steel tanks and G.I. tanks shall come under scope of this specification. Reservoirs made of concrete masonry or fabricated steel shall be covered by respective work specifications.
1.23.1.4 Related Works:

All works, like earthwork, masonry, concrete, steel work, cutting holes, chases, repairs and rectifications associated directly with installation of water supply systems shall come under scope of the contractor unless specifically excluded. These works are not detailed out in this specification.

1.23.1.5 Regulations:

The work which is required to be carried out under the scope of this section, shall only be executed by a licensed plumber engaged by the Contractor and he shall obtain all necessary sanctions, permissions, certificates etc. from Municipal and or other Authorities and shall abide by all the rules of such Authorities.

1.23.2 Installation:

While basic layouts may be available in the drawings provided by the Owner, the details might have to be supplemented by the contractor for approval of the Engineer.

Special attention shall be given by the Contractor to economy. Symmetry layout is very important. Fittings meant for operation shall be located and oriented to allow easy reach and operation. Maintenance, repairs and replacements of pipes, fittings and fixtures must be conveniently possible.

1.23.2.1 Pipe Lines:

1.23.2.1.1 Laying:

In addition to fulfilling the functional requirements all pipelines shall be laid true to line, plumb and level. Any deviation shall need approval of the Engineer. Meticulous care shall be taken to avoid chances of airlock and water hammer.

Pipes shall be laid on continuous unyielding surface or on reliable supports at least one near each joint and spacing as directed by the Engineer. The support must be strong, neat and shall have provisions for securing the pipes in every direction and easy maintenance. Pipes shall be encased or concealed in masonry or concrete if shown on drawing or directed by the Engineer.

1.23.2.1.2 Back Flow:

The layout of pipe work shall be such that there is no possibility of backflow towards the source of supply from any cistern or appliances, whether by siphonage or otherwise. All pipe works shall be so laid or fixed and maintained as to be and to remain completely water-tight, thereby avoiding waste of water, damage to property and the risk of contamination of the water conveyed.
1.23.2.1.3 Contamination:

There shall be no cross connection whatsoever between a pipe or fitting for conveying or containing wholesome water and a pipe or fitting for containing impure water or water liable to contamination or of uncertain quality or water which has been used for any purpose.

No piping shall be laid or fixed so as to pass into or through any sewer, scour outlet or drain or any manhole connected therewith.

1.23.2.1.4 Underground Piping:

Underground piping shall be laid at such a depth that it is not likely to be damaged by traffic and other loads and frost, where applicable.

The size and depth of the trench shall be as approved by the Engineer. Backfilling shall be done with selected fine earth, unless otherwise permitted, in 150 mm layers and carefully consolidated. Special care shall be taken while filling in the vicinity of the pipe to avoid damages. Before backfilling the laid pipe shall be fully tested and approved.

Where the pipe rests on rock it may be bedded on a layer of fine selected material or concrete to avoid local point support.

If the pipeline (except G.I pipelines) is required to be laid in black cotton soil, it shall be ensured that the pipe is encased 200 mm in sides and 300 mm minimum on top and bottom with sand before the rest of the trench is backfilled with selected earth.

The trench shall be so treated by gradient and filling in the area that it does not act as a drainage channel.

1.23.2.1.5 Concealed piping:

Where desired by the Engineer or shown on the drawings the pipes shall be concealed in masonry or concrete of the structure. The contractor may coordinate with the building contractor for leaving the chases, openings, conduits as necessary. However, the contractor will rectify, if required, the chases, openings and conduits, supplement and make good after laying and testing of the concealed pipelines.

1.23.2.1.6 Jointing of Pipes:

Jointing of pipes shall be completely leakproof and durable. Instruction of the manufacturer shall be followed unless desired otherwise by the Engineer. However, usually recommended practices are stated below for guidance:
a) Cast Iron :

i) Spigot and Socket Joints :

Lead joint : The joint is made by first caulking in clean spun yarn upto half depth and filling the remainder by running in molten lead taking care that no dross enters the joint and then thoroughly caulking the lead. The lead need not extend into the joint further than the back of the groove formed in the socket. After completing the joint it shall not be allowed to move. For rectification the joint shall be completely redone.

ii) Flanged joints :

Flanged joints shall be made by jointing rings of good quality, smooth and hard compressed fibre board of thickness not less than 1.5mm and of such width as to fit inside the circle of bolt. Diagonally apposite bolts shall be tightened in pairs and in stages so that degree of all bolts in a joint are similar. Damaged gaskets shall be replaced.

b) Steel :

Plain ended steel pipes may be jointed by welding. Screwed and socketed joints shall be carefully tightened. Care shall be taken to remove any burr from the ends of the pipes. Jointing compound, if used, shall be lead free and approved by the Engineer.

c) G.I pipes :

Threads shall be cut with sharp tools, and before jointing all scales shall be removed from pipes by suitable means. The screw threads of the pipe shall be cleaned out and the joint made by screwing the fittings after treating the threads with approved pipe jointing compound. Once a joint has been screwed up it shall not be backed off unless the threads are recleaned and new compound applied.

d) Asbestos cement pipes :

Socket and spigot ended pipes shall be jointed by caulking with tarred gasket and grouted with 1:3 cement sand mortar.

e) Lead :

Lead and lead alloy pipes shall be jointed with wiped solder joints.

f) Concrete :

Concrete pipes may be socket and spigot ended, collar or hand jointed. Jointing shall be effected by caulking with 1:3 cement sand mortar.
g) PVC:
Manufacturer’s instruction shall be followed. For beating approved equipment with adequate control shall be used.

h) Tyton joint:
The manufacturer’s instruction shall be strictly followed in making such joints. Tyton joints shall be made by push-on type ‘tyton’ rubber gasket and such rubber gasket shall conform to the specification stipulated by the pipe manufacturer. The tools specified by the pipe manufacturer shall be used to secure the joint fully.

1.23.2.1.7 Painting:
Where mentioned in the Schedule, underground steel and cast iron pipes shall be given 2 coats of bituminous paint on the outside after laying, when painting is to be done above ground. G.I. pipes shall be given a coat of zinc chromate primer, C.I & M.S pipes shall be given one coat of best quality paint.

1.23.2.2 Storage Tank:
Unless otherwise mentioned, water storage tanks shall be of RCC conforming to relevant IS specifications. Relevant specifications for RCC work shall be followed as elaborated in Section - 2.5 of this document. The following type of tanks may also be provided in case of overhead tanks over the respective buildings if so desired by the Employer:

1.23.2.2.1 Pressed Steel Tank:
Such water storage tanks shall be pressed steel tanks of nominal size and capacity as mentioned in the schedule and fabricated with all flanges external, all flanges internal or bottom flange internal and side flanges external, as shown on approved drawing. The tenderer shall supply 6 prints of fabrication drawing to the Engineer for prior approval showing thickness of plates, method of jointing the plates, all supports, gussets, pads, cleats etc., required for supporting the tanks, shall be supplied by the manufacturer. Inlet, overflow, vent pipes, manholes etc. shall be arranged and provided as shown on drawing or mentioned in the schedule. Unless otherwise specified, the outlet pipe shall be 50 mm above the bottom of the tank and there shall be a 150 mm free board at the top of the tank.

All tanks shall be supplied with mosquito-proof covered top with manholes not less than 450mm diameter. Tanks deeper than 1.00 metre shall be provided with M.S internal access ladder adjacent to the manhole. Water level indicator shall be provided if asked for.
Two coats of anti-corrosive paint over a suitable primer shall be applied to both internal and external surface of tank. The internal paint if used shall be such as not to impart any taste or odour to water and be of lead free composition.

Erection of tanks shall be in accordance with detailed drawings and manufacturer's instructions. The two finishing coats of paint shall be applied to outside after erection is complete.

1.23.2.2 G.I. water tank:

G.I. water tank shall be procured from a reputed manufacturer. The design shall be good enough to withstand the loads safely. Galvanised iron water storage tank shall be made of minimum 2 mm thick galvanised iron sheet. Plain sheets shall be fixed at the corner to angle iron frames by means of 6 mm rivets at 40 mm pitch for tanks upto 1000 litres capacity and 8 mm rivets at 35 mm pitch for tanks above 1000 litres capacity. Tanks above 1000 litres shall have 20 mm dia galvanised iron stay rods, one fixed to angle framing at top and two in the body of the tank for extra strength. Holes for rivetting shall be drilled and not punched. White lead shall be applied to the joints before rivetting.

In case it is desired by the Engineer that corners of tank should be welded instead of rivetted then the sheets shall be welded to form a tank and will not have angle iron frame.

Tanks shall have 400 mm dia holes at the top with hinged covers. The covers shall be made of galvanised iron sheet with angle iron frame. The cover shall be just loose but close fitting to keep out dust and will not be airtight. It shall be complete with lockable arrangement.

Tanks shall be provided with rising main inlet of 40 mm dia galvanised iron pipe or as shown on drawing and 25mm dia G.I. overflow pipe. The rising main shall be connected to the tank with a ball valve near the top which disconnects the supply when tank is full up to the point of overflowing.

The ball valve permits the entry of water when the tank is empty and disconnects the supply when the tank is full. It consists of a hollow floating ball made of copper, plastic or hard rubber, 110 mm in diameter, attached to an arm which is so pivoted that the end near the pivot closes the orifice of the main when the ball is raised to the required height of water in the tank and opens the main as soon as the ball drops with the fall of water level as it is drawn off through the distribution pipes.
The ball valve shall be fixed to the tank independent of the inlet pipe and set in such a position that the body of the ball valve cannot submerge when the tank is full up to the water line. The ball valve shall be so adjusted as to limit the level of the water in the tank to 25 mm below the lip of the overflow pipe. Free surface shall be about 15 cm above the maximum water filled level.

1.23.2.3 Valves, Cocks, Bib Taps:

All valves, stop cocks, taps etc. shall conform to relevant Indian Standard Specifications and shall be of best quality from approved manufacturers. These shall be suitable for working pressures mentioned in approval schedule. Nominal size and material shall be as per approved schedule.

1.23.2.4 Protection:

Open end of each pipe shall be protected during installation by suitable covers or plugs so that the ends, threads, socket or spigot are not damaged and no foreign material can find its way into the pipeline.

Fittings and fixtures liable to be misused or stolen during the construction phase shall be fitted only before testing and handing over.

1.23.3 TESTING AND ACCEPTANCE:

In general, the work should pass all necessary and relevant Quality Control Tests including the following tests:

1.23.3.1 Inspection before Installation:

All pipes, fittings and appliances shall be inspected before delivery at the site to see whether they conform to accepted standards. The pipes and fittings shall be inspected on site before laying and shall be sounded to disclose cracks. Any defective items shall be clearly marked as rejected and forthwith removed from the site.

1.23.3.2 Testing of mains after laying:

After laying and jointing, the main shall be slowly and carefully charged with water, so that all air is expelled from the main by providing a 25 mm inlet with a stop-cock, allowed to stand full of water for a few days if time permits and then tested under pressure. The test pressure shall be 5 Kg/cm or double the maximum working pressure, whichever is greater.
The pressure shall be applied by means of a manually operated test pump or in the case of long mains or mains of a large diameter, by a power driver test pump, provided that the pump is not left unattended. In either case due precaution shall be taken to ensure that the required test pressure is not exceeded.

Pressure gauges shall be accurate and shall preferably have been recalibrated before the test. The pump having been stopped, the test pressure shall maintain itself without measurable loss for at least five minutes. The end of the main shall be closed by fitting a water-tight expanding plug and the plug shall be secured by struts to resist the end thrust of the water pressure in the mains.

1.23.3.3 Testing of service pipes and fittings:
The service pipes shall be slowly and carefully charged with water allowing all air to escape avoiding all shock or water hammer. The service pipe shall then be inspected under working conditions of pressure and flow. When all draw-off taps are closed, the service pipes shall be absolutely watertight. All piping, fittings and appliances shall be checked for satisfactory support and protection from damage, corrosion and frost.

1.23.4 I.S.CODES:
All relevant latest IS Codes/CPWD/NBO/International Standards shall be followed. A few of them are mentioned below:

IS:2065 - Code of practice for water supply in buildings.
IS:1172 - Code of basic requirements for water supply, drainage and sanitation.
IS:1200 - Laying of water and sewer lines including appurtenant items. (part-XVI)
IS:1239 - Specification for Mild Stub Tubes and Mild Stub Tubular and other Wrought Stub pipe fittings (10 mm to 15 mm nominal diameter). (part-I &II)
IS:1536 - Specification for centrifugally cast (spun) item pressure pipes for water gas and sewage.
IS:1537 - Specification for vertically cast iron pressure pipe for water, gas & sewage.
IS:3486 - Specification for cast iron spigot and socket drain pipes (80 mm to 250 mm nominal diameter).
IS:3589 - Specification for electrically welded steel pipe for water, gas and sewage (200 mm to 2000 mm nominal diameter).
IS:784 - Pre-stress concrete pipes.
IS: 458 - Concrete pipes (with or without reinforcement).
IS:1592 - Asbestos cement pressure pipes.
IS:1626 - Asbestos cement pipes, gutters and fittings (spigot and socket types).
IS: 404 - Lead pipes.
IS: 3076 - Low density polyethylene pipes for potable water supplies.
IS: 4984 - High density polyethylene pipes for potable water supplies.
IS: 2501 - Copper tubes for general engineering purposes.
IS: 407 - Brass tubes for general engineering purposes.
IS:1230 - Cast iron rain water pipes and fittings.
IS: 804 - Rectangular pressed steel tanks.
SUB-SECTION-7.5.1 (MECHANICAL) DETAILS (DATA SHEET) REQUIRED WITH THE OFFER

The offer must be complete with the following details for correct appreciation of the proposal. The offers will be treated as incomplete and may be passed over if the data as asked for, are not submitted along with the offer.

1.0 General
   a) Plant description as envisaged.
   b) System drawings of the plant.
   c) Scope of supply.
   d) List of spares forming part of scope of supply.
   e) Equipment specifications.
   f) Deviations from the NIT, if any.
   g) Manufacturer’s printed pamphlet
   h) List of spares for next three years operations.
   i) Any additional alternative provisions.

2.0 Mechanical
2.1 Crushing Plant
2.1.1 Rock Breaker
   a) Maximum horizontal reach with breaker.
   b) Maximum vertical reach with breaker.
   c) Swing rotation of Boom.
   d) Minimum head room.
   e) Weight of boom and pedestal.
   f) Total weight of the equipment.
   g) Make, HP of motor etc.
   h) Maker’s illustrative pamphlets and literature etc.
   i) Past performance of such equipment along with list of users and details of application.
   j) General arrangement drawing along with broad dimensions
   k) Literature /pamphlet of the manufacturer
   l) Type of rock breaker
2.1.2 **Single roll Crusher and Twin shaft sizer (as per specification)**

i) Type, size and make

ii) Capacity parameters

   a) The rated capacity of the crusher in t/hour at indicated feed and product size. The rated capacity per annum and capacity at different settings should also be indicated.

   b) The approximate product analysis, say the percentage of (+) 100 mm size and maximum size of coal at different settings in the final product.

   c) Percentage of generation of fines during the crushing operation and variation in capacity due to variation in moisture in ROM feed.

iii) Technical Parameters

   a) Overall dimension and weight of the crusher/ sizer indicating total installed height above ground level.

   b) Weights and dimensions of major assemblies and sub-assemblies, and capacity of E.O.T. crane for maintenance/overhauling work.

   c) Impact load Imparted to the foundation while crushing is in operation.

   d) Horsepower’s of different motors and ratings of reducers coupling along with its type, size, model and make.

   f) Details of bearing and sealing arrangement.

   g) Details of lubrication arrangement.

   h) Details of hydraulic system.

   i) Material specification and mechanical properties of main components of the crusher /sizer such as spider assembly, main body, mantle, concave, sleeve, drive shaft, bevel gears and main shaft assembly.

   j) Power requirement of the system at different load conditions.

   k) Details of control and safety devices incorporated in the crusher /sizer, specially with reference to tramp iron.

   l) Calculation in support of Power requirement and capacity of the Crusher.

   m) Details of lubricating oil and hydraulic fluid and other consumables with their consumption pattern over a period.

2.1.3 **Heavy duty Apron Feeder**

a) Type, size and number offered.

b) Make

c) Capacity TPH with range of variable capacity.

d) Length, breadth and height of skirt board.

e) Width between skirts.

f) Length between sprocket centre.

g) Motor power (KW) and its supporting calculations.

h) Motor RPM.
i) Speed of Apron feeder
j) Details of proper mechanism to set the feeder at desired rate.
k) Weight of Apron feeder with motor.
l) Type, size and make of bearings used.
m) Material offered for main frame, side board, pans (Aprons), conveyor chains, Impact and carrier rollers, sprockets, shafts etc. including their ultimate tensile strength in kg/mm², % elongation and Brinell hardness number.
n) Lubrication arrangement envisaged for roller bearings, chain pins, etc with all details.
o) Provision of wear resistant replaceable liners in pans etc.
p) Details of spillage collecting conveyor.
q) Details of heavy-duty conveyor chains viz. Make, type, size pitch and strength.
r) Details of variable speed drive arrangement.
s) Details of drive motor, reducers, coupling etc.
t) Drawings
   i) General arrangement dimensioned drawing of apron feeder with motor. ii) Foundation arrangement drawing with anchor bolt positions and load for feeder with motor. iii) Drive arrangement details. iv) Feeding and discharge chute details.
u) Maker’s descriptive pamphlets.
v) Detailed equipment specification with construction features.

2.1.4 EOT Crane
a) Type and make of the cane.
b) Lifting, cross traversing and long traversing speeds.
c) Details of all motors along with reducers coupling, etc.
d) Power feeding arrangement.
e) A general arrangement drawing along with overall dimensions.
f) Maker’s illustrative pamphlets and literature.

2.2 Chutes of silo feed conveyor
a) Chute material
b) Thickness of material
c) Type and material of liner
d) Thickness of liner
e) Slope of chute
f) In side dimension of chute
g) Number of discharge chutes

23 Flap Gates
a) Type and size of the actuator
b) Name of manufacturer
c) Motor power
d) Actuator travel distance
e) Material used for gate construction
f) Thickness and material of liner provided
g) Number of Flap Gates

24 Sampling system
a) Primary Sampling Machine
b) Type and make of Sample Cutter
c) Cutter opening (mm)
d) Cutter speed (mm/sec.)
e) Number of increment/hour
f) Kilograms/cut
h) Total quantity of sample/hour(kgs.)
i) Type of cutter drive
j) Drive power
k) Material of construction
l) General construction features

25 Sampler screw/ belt Feeders
a) Number of feeders
b) Capacity (TPH)
c) Belt width and length
d) Belt speed
e) Material size
f) Drive power
g) Make

2.6 Secondary Sampling system
a) secondary Sampling Machine
b) Type and make of Sampling machine
c) Crusher details
d) Bias connection details
e) Number of increment/hour
f) Kilograms/cut
g) Total quantity of sample/hour (kgs.)

h) Type of crusher drive

i) Drive power

j) Material of construction

2.7 **Sample System Chutes:**

a) Chute Material

b) Thickness of chute material

c) Type of liner

d) Liner thickness

e) Minimum slope of chutes

f) No. of sections.

2.8 **Sampling System Controls:**

a) Description of control system

b) Specific technical details

c) Power and control drawing of sampling system

d) Make

2.9 **Silo**

a) Inside diameter of silo (M)

b) Height of silo roof top from rail top (M)

c) Struck volume of silo (Cu.M.)

d) Silo side slopes (Degrees)

e) Construction material details

f) Number of holes provided for fitting of pneumatic arch breaker and other accessories.

g) Thickness, grade and height of stainless steel liner (mm)

h) Thickness of Ferro site lining (mm)

i) Any other relevant details.

2.10 **Level Indicators**

a) Type of level indicators provided

b) Name of the manufacturer

c) Number of level sensors

d) Type of control (Manual/automatic)

e) Audio-visual alarms

f) Level measuring device (Constructional/operational features)

1.11 **Pneumatic arch breakers:**
1.12 Type and size

a) Name of the manufacturer  
b) Volume of air discharged (Cu.M.)  
c) Air pressure (BAR)  
e) Release time (Sec.)  
f) Required size of hole in silo wall  
g) Capacity of the air canon in liters.  
h) General construction and operational features with reference to typical drawings.

2.12 Air compressor

a) Type and size of Air compressor  
b) Name of the manufacturer  
c) Piston displacement (Cu.M./Hr.)  
d) Delivery pressure (BAR)  
e) Number of cylinders  
f) Capacity of Air Receiver (Cu.M.)  
g) Drive Motor Power (KW)  
h) Constructional/Operational details.

2.13 LOAD –OUT SYSTEM

2.13.1 Silo Outlet Gates:

a) Type of Gates  
b) Number of Gates  
c) Opening size of gates  
d) Number of hydraulic cylinders used for each gate operation  
e) Minimum opening time of each gate (Seconds)  
f) Minimum closing time for each gate (Seconds)  
g) Hydraulic cylinder operating pressure (BAR)  
h) Loading time for complete filling of 60 Te. Capacity pre-weigh Hopper (Seconds)  
i) Numbers of Inter Locks and Signalling system provided (Explain)  
j) Make and any other relevant details including technical features.
2.13.2 Pre-Weigh Hopper:

a) Struck volume (Cu.m.)

b) Useful volume (Cu.m.)

c) Angle of sloping sides (Degree)

c) Thickness of steel plates used (mm)

d) Type of liner material

e) Thickness of liner material (mm)

f) Load cell details, numbers, make and construction features.

2.13.3 Flood Loading System:

a) Type of gate

b) Opening size of gate

b) Number of hydraulic cylinders used for gate operation

d) Minimum opening time of each gate (seconds)

e) Minimum closing time of each gate (seconds)

f) Hydraulic cylinder operating pressure (BAR)

g) Maximum closing force at above pressure (tonnes)

h) Minimum discharge time for emptying out the pre-weigh hopper (seconds)

i) No. of inter locks and signalling including positionar (Explain)

2.13.4 swing chute system

a) Inside opening of the Chute

b) Thickness of steel plates used (mm)

c) Type of liner material

d) Thickness of liner material (mm)

e) Minimum height of Chute from Rail Top (M)

f) Maximum height of Chute from Rail Top (M)

g) Type of material used for side skirt plate
h) Width and thickness of skirt plate
i) Drive system detail including interlocks and signalling.

2.13.5 **Hydraulic system**

2.13.5.1 **Hydraulic Power Pack**

a) Number of hydraulic power pack
b) Name of manufacturer
c) Reservoir capacity (Litres)
d) Type of hydraulic pump
e) Pump capacity (Litres/Min.)
f) Oil flow (Litres/Min.)
g) Operating pressure (BAR)
h) Test pressure (BAR)
i) Type of filter
j) Filteration (Microns)
k) Type of the hydraulic oil
m) Approx. life of hydraulic oil
n) Type of gauges provided
o) Drive motor power
p) Complete hydraulic circuit
q) Constructional and operational features.

2.13.5.2 **Hydraulic Accumulator**:

a) Type of accumulator
b) Volume of hydraulic accumulator
c) Description of accumulator operating system and other constructional detail
d) Make

2.13.5.3 **Hydraulic Cylinders**:

a) Bore and stroke of hydraulic cylinders (mm)
b) Operating pressure (BAR)
c) Test pressure (BAR)
d) Material of construction

e) Make

2.13.5.4 Pre-weigh System Calibration :

a) Type of calibration system

b) Calibration weights (Te.)

c) Number of calibration weights and denomination provided

d) Description of the calibration system

e) Make

2.14 Dust control system

2.14.1 Dust Control at Conveyor Discharge Chute :

a) Number of nozzles for each discharge chute

b) Consumptive water requirement for each nozzle (Cu.M./Hr.)

c) Operating pressure (BAR)

d) Nozzle office diameter (mm)

e) Material of construction of nozzles.

f) Name of manufacturer of nozzles

g) Total quantum of water required for dust suppression of discharge chutes (Cu.M./Hr.)

h) Quantum of dust suppressant required (Cu.M/Hr.)

i) Number of pumps provided

j) Pump capacity (Water) (Cu.M/Hr.)

k) Terminal head (M)

l) Pump capacity (Suppressant) (Cu.M/Hr.)

m) Terminal head (Metres)

n) Supressant tank capacity if any (Cu.M./Hr.)

o) Drive motor power for the pumps (KW)

p) Details of pump including make

2.14.2 Dust Control Between Silo Outlet Gates & Pre-weigh Hopper

Type of dust control arrangement

a) Scheme for disposal of coal laden air

b) Flexible cover duct provided (if any)

c) Constructional and operational detail

d) Make

2.14.3 Dust Control during Wagon Loading :

a) Number of nozzles for each loading point

b) Consumptive water requirement for each nozzle (Cu.M./Hr.)
c) Operating pressure (BAR)
d) nozzle Orifice diameter (MM)

e) Material of construction of nozzles
f) Name of manufacturer of nozzles
g) Total quantum of water required for dust suppression (Cu.M./Hr.)
h) Type of dust suppressant provided (if any)
i) Quantum of dust suppressant required (Cu.M/hr)
j) Number of pumps required
k) Pump capacity (water) (Cu.M./Hr.)
l) Terminal head (M)
m) Pump capacity (Suppressant – Cu.M./Hr.)
n) Termination head (M)
o) Suppressant tank capacity (Cu.M.)
p) Drive motor power for pumps (KW)
q) Pump details including make

2.15 Passenger lift details at silo

a) Name of the manufacturer
b) Capacity – Number of persons
c) Freight capacity – Kgs.
d) Speed of the lift (M./Sec.)
e) Travel (Metres)
f) Number of floor served
g) Location of machine room
h) Location of counter weight
i) Size of car platform
j) Type and size of car door
k) Type and size of landing door
m) Construction feature of car body
n) Type of locking devices for landing doors
o) Type of indicators provided
p) Rope construction details including size and make
q) Drive motor power

2.16 Hoist and chain pulley block:
a) Number of electric hoists and chain pulley blocks provided
b) Location of electric hoists and chain pulley blocks
d) Lifting capacity (Te.)
e) Height of lift (Metres)
f) Motor power

2.17 Fire fighting system

2.17.1 Fire Detection Equipment:
   a) Make
   b) Type
   c) Constructional features
   d) Pump capacity recommended (Cu.M./Hr.)
   e) Drive motor power for pump (KW)
   f) System description
   g) Any other relevant details.

2.17.2 Inert gas fire fighting
   a) System description of inert gas fire fighting
   b) Details of pipeline network
   c) Operating pressure
   d) Minimum number of standard gas cylinders to be maintained.
   e) Any other relevant details
   f) Portable fire extinguishers
   g) Type of the fire extinguishers
   h) Make of fire extinguisher
   i) Number and location of fire extinguishers

2.18 Belt Conveyor (Data shall be given conveyor wise)

2.18.1 Drums (All types)
   a) Diameter (OD).
   b) Shell thickness.
   c) Diameter of shaft and length.
   d) Material of shaft.
e) Size and type of bearings.

f) Type of construction of drums.

g) Details of ribs and stiffeners provided inside the drum shell.

h) Type of shaft and hub connections.

i) Type of sealing, if any for the bearings.

j) Lubrication arrangements.

k) Bearing life guaranteed for (hours).

l) Out of roundness of the drums.

m) Type of lagging on drive drums and details.

n) Weight of each drum.

O) Make.

2.18.2 Idlers (All Types)

a) Diameter (OD).

b) Length of roller.

c) Wall thickness of the tube.

d) Diameter or shaft and its length.

e) Material of shaft.

f) Size and type of bearings.

g) Details of sealing arrangement.

h) Approximate capacity of grease cavity.

i) Whether end shell can be opened for re-grease or not.

j) Bearing life guaranteed for (hours).

k) Maximum eccentricity/ovality of the idler.

l) Idler tube construction – Seamless/ER W.

m) Weight of idler set.

n) Weight of moving parts.

o) Shore hardness of rubber disc for impact idlers.

p) Spacing.

q) Friction factor.

2.18.3 Idler Bracket

a) Detailed dimensioned drawings.

b) Details of fixing of brackets showing allowance for shifting the idler sets.
2.18.4 Intermediate structures (Technological)
   a) Size
   b) Length
   c) Width
   d) Details of stool
   e) Centre of foundation holes

2.18.5 Tail end frame
   a) Size of channel/beam used
   b) Foundation details
   c) GA drawing

2.18.6 Take-up details
   a) GA drawing with broad dimensions
   b) Take-up weights and method of attachment details

2.18.7 Drive Unit Motor
   a) Kilo Watt, Voltage, RPM, frequency.
   b) Make.
   c) Starting torque.
   d) Full load torque.
   e) Starting current.
   f) Full load current.
   g) Power factor.
   h) Insulation class.
   i) Type of enclosure.

2.18.8 Gearbox
   a) Make.
   b) Type and size.
   c) Speed ratio.
   d) Output transmitting capacity.
   e) Service factor used.
   f) Efficiency.
   g) Input & output shaft dia

2.18.9 Coupling (Both High Speed & Low Speed)
   a) Type.
   b) Make.
   c) Size.
   d) Input / output bore details
   e) Service factor.
2.18.10 **Fluid Couplings**
   a) Type.
   b) Make.
   c) Size.
   d) Rating

2.18.11 **Anti Roll Back Device**
   a) Type.
   b) Make.
   c) Size.
   d) Capacity in kilogram-metres.

2.18.12 **Pull Chord Switches**
   a) Type.
   b) Make.
   c) Spacing and number.

2.18.13 **Belt Sway Switches**
   a) Type.
   b) Make.
   c) Spacing and number.

2.18.14 **Belt Slip Switches**
   a) Type.
   b) Make.
   c) Spacing and number.

2.18.15 **Fixed Tripper**
   a) GA drawing of Tripper along with broad dimensions & construction.
   b) Chute supporting details

2.18.16 **Weights of the following :**
   a) Drive unit consisting of motor, reduction drive drums, couplings and anti roll back device, common bad and frame etc.
   b) Head drum assembly.
   c) Tail drum assembly.
   d) Take up assembly.
   e) Tripper carriage.
   f) Weight per metre run of conveyor excluding belts.
2.18.17 **Drawings with offer**

The following drawings in triplicate shall accompany the offer failing which it may be passed over. All drawings shall conform to IS 696 and all dimensions shall be in millimetres.

a) General arrangement dimensioned sketch of complete conveyor.

b) Drive unit and discharge drum assembly indicating plan, side and front views complete with all important dimensions and clearances including belt hole centres for foundation.

c) Tail drum arrangement.
d) Take up arrangement.

e) Construction drawing of typical idlers showing all important details.

f) Tripper arrangement

2.18.18 Belting (NYLON/ NYLON)

a) Type of belt carcass.

b) Breaking load for warp & weft.

c) Elongation at breaker(%).

d) Max. recommended full thickness working tension in kN/m.

e) Belt weigh in kg/cm width/m length.

f) Tensile strength in kg/sq.m. for belt cover.

g) Elongation at break in percentage for belt cover. h)

Grade of cover and its abrasive value.

i) S.F. assumed for belt strength. j)

Face cover thickness. k) Back

cover thickness. l) Adhesion

strength kg/cm. m) Between cover

& ply. n) Between ply & ply.

O) Percentage of strength .

p) Troughability of belt.

2.19 Belt Weighers

a) Specification in detail in respect of various accessories and systems provided

with the equipment including the features elaborated in this specification.

b) General arrangement drawings of the equipment giving broad dimensions

and indicating its various functionaries.

c) Manufacturer’s descriptive pamphlets giving details of various constructional

features of the equipment and of various individual components.

d) Weighing range for each unit.

e) Percentage accuracy over the entire weighting range.

f) Provision of zone adjustment derail.

g) Type of totaliser and details.

h) Type of sensing equipment and details.

i) Speed sensing device details.

j) Weigh bridge type and details and weighing length.

k) Rate indicator type and details.

l) Details of integrating mechanism.

m) Power supply required.

2.20 Electric Hoist (Details as per location shall be submitted)
a) Capacity.
b) Lifting end lowering height.
c) Lifting speed.
d) Traversing distance.
e) Traversing speed.
f) Motor HP.
g) Type of power feeding arrangement.
h) Type of structural support.
i) Make and Maker's illustration pamphlets.

2.21 Foreign Metal Picker and Detector
a) A brief description of detector and picker with its technical parameters.
b) Type of input power i.e. whether AC or DC is to be used.
c) Specified controls and hooter provided.
d) Type and composition of metals where it can be effectively used.
e) Maximum weight and volume of foreign metal which can be lifted from the conveyor head.
f) Type and make of the equipment.
g) General arrangement drawing of detector and picker.
h) Maker's illustrative pamphlets and literature and the details of past supply.

2.22 Motorised Flap Gate
a) Type of flap gate used whether electrically / hydraulically operated
b) If electrically /hydraulically operated then type and number of limit switches used, make, HP of motor, RPM, maximum starting torque, etc of the motor shall be given. Type of the speed reduction unit, the stages of speed reduction, type of the bearings used, etc. should also be given.
c) A general arrangement drawing with overall dimensions.
d) Maker's illustrative pamphlets and literature.

2.23 Chute and Liners
a) The material used for chutes and stiffness.
b) The thickness of chute walls.
c) Valley angles of chutes.
d) The type and thickness of lining used in case of chutes, the characteristics of the material used and if possible its life in working hours.
e) General arrangement drawings along with maker's illustrative pamphlets literature for lining material.

2.24 Sump Pumps
a) Type, Number offered and capacity of the pump and its discharge head.
b) The size of inlet and outlet of the pump.
c) Make, type and power (kW) of the motor used.
d) The type of foot valve, strainer and other valves used.
e) A drawing showing complete arrangement of the system.
f) Maker’s illustrative pamphlet and its literature.

2.25 **Chain Pulley Block** (Details as per location shall be indicated)

a) Make.
b) Capacity.
c) Lift.
d) Size of hanging structure.
e) Pull required in kg at full load.
f) Maker’s illustrative pamphlet.

2.26 **Dust Suppression System** (Details as per location wise shall be given)

a) A line diagram of the suppression arrangement (showing location of nozzles, pumps and layout of pipeline from reservoir to various distribution zone).
b) Details of piping, fittings, pumps and nozzles. The material construction for nozzles, pipes and reservoirs.
c) The details of water storage tanks used. Pressure and quantity of water required for nozzle.
d) Details of chemicals to be used, its consumption availability and approximate price.
e) Details of chemical storage tank, its mixing arrangement and a line diagram of flow.
f) Illustrative literature for dust suppression plant in general.
g) Make of different items like pumps, fittings, nozzles, pipes etc.

2.27 **Dust Extraction System** (Details as per location wise shall be given)

a) Assumptions made regarding dust concentration, dust size and its distribution over individual points along with the evidence to prove.
b) Size of suction hood, pressure in water gauge, quantity and velocity of air required at each point with supporting calculations.
c) Such of ducts at various point locations along with a line sketch starting from suction hood to discharge point in atmosphere. This should be supported along with detailed calculations.
d) Specific reasons for selection of a particular system of dust collection and the advantage over others.
e) Type, size, power required and capacity of dust collector and dust disposal arrangement along with supporting calculations.
f) Efficiency of dust collector for different sizes of dust and percentage of dust that escapes through exit.
g) Concentration of left out dust in air in the vicinity of dust collection points and details of ability to prove the same by tests.
h) Approximate amount of dust collected/hour and different sizes of dust from each installation. i) Velocity of air at the exit and discharge height.

j) Total length of ducting its thickness, approximate weight and likely material to be used in view of abrasiveness of coal, silica and shale particles.

k) Total weight of the collector, type, thickness and life of lining in the collector, if any.

l) Details of anti corrosive painting, its method of application and list of brought out items along with a list of their manufacturers. m) A general arrangement drawing of the whole system with overall dimensions.

2.28 **Ventilation System (Details as per location wise shall be given)**

a) Make, type, size and power required of the fan to be used for ventilation.

b) Technical Specification / features of tanks.

c) Manufacturer’s pamphlets.

d) Number of air changes per hour proposed for the area where ventilation is to be done.

2.29 **Electric Motors (Details as per location wise shall be given)**

Note: The tenderer shall furnish the complete details for all the drive motors:

a) Maker’s name.

b) Standard to which the motor conforms.

c) Equipment driven by motor.

d) Motor type.

e) Type of duty.

f) Type of enclosure and mounting.

g) Method of cooling.

h) Standard continuous rating. kW.

i) Rated speed at rated voltage and frequency, rpm

j) Permissible variation of
   i) Voltage. Volts ii) Frequency, Hz
   (Not less than asked for in the specification)

k) Minimum permissible starting voltage*, volts.
   (*Not less than asked for in the specification.)

l) Full load and no load current at rated voltage and frequency.

m) Power factor at 100%, 75% and no load Efficiency of motor at design duty point. (100%, 75% and 50% load at rated voltage and frequency).

n) Starting current at 100%, 85% and 80% voltage.

o) Torque (kg-m) at starting, rated load, pull up and pull out.

p) Stator winding insulation
   i) Class and type
ii) Whether tropicalised.
   iii) Temp. rise over specified ambient of 50°C.
q) Stator winding connection and resistance per phase.
r) Number or stator terminals brought out.
s) Starting time with minimum permissible voltage of ........ % of rated voltage.
   i) without driven equipment coupled
   ii) with driven equipment coupled.
u) Type of terminal box for space heater, temperature detector, instrument
   switches, cable connection etc. v)
   Space heaters
   i) Maker’s name and type
   ii) Number
   iii) Location
   iv) Rated voltage
   v) Rated power
   vi) Whether thermostat provided.
w) Bearings
   i) Type of bearing at driving end.
   ii) Type of bearing at non-driving end.
   iii) Maker’s name.
   iv) Recommendation lubricant.
x) Type of construction of rotor.
y) Weight of motor stator, rotor and total, weight.
z) Main terminal box
   i) Location
   ii) Entry of cables.
   iii) Recommended cable size
   iv) Fault level
   aa) Temperature detector for stator winding and bearing
      i) Numbers provided
      ii) Location and maker’s name
      iii) Resistance – Value.
   bb) Whether indication for winding and bearing temperatures have been carried
      over to the control desk.
cc) Temperature switch for bearings.
   j) Type and make
   ii) Accuracy and range
   iii) Connection type and size

dd) Characteristics curves
   i) Torque speed characteristics
   ii) Time Vs starting current

   iii) Thermal withstand curves

ee) Technical literatures

2.30 Condition Monitoring System

a) Model
b) Make
c) Description of the CMS offered
d) Transducer Types
   i) Bearing Monitoring (Numbers with major operating technical parameters)
   ii) Vibration monitoring (Numbers with major operating technical parameters)
   iii) RPM monitoring (Numbers with major operating technical parameters)
   iv) Temperature monitoring (Numbers with major operating technical parameters)
   v) Analogue Signal monitoring (Numbers with major operating technical parameters)
   vi) Others if any (Numbers with major operating technical parameters)
e) Monitoring/display Units
   i) Bearing Monitoring (Numbers with major operating technical parameters)
   ii) Vibration Monitoring (Numbers with major operating technical parameters)
   iii) RPM Monitoring (Numbers with major operating technical parameters)
   iv) Monitoring of Analogue Signals (Numbers with major operating technical parameters)
f) Operating Software
   i) Type of software
ii) Make

iii) Specific features of the software and the operations it can perform

g) Hardware

i) PC make/type & configuration

ii) Printer make & configuration

2.31 Vulcanising Machines

a) Suitable for - Belt Vulcanising
   Longitudinal rip repair - yes/no
   Spot repair - yes/no

b) Make

c) Quantity

d) Belt Specification -- Type of
   belt --Width --

e) Thickness --

f) Rating --

g) Splice length

e) Max length of belt Vulcanised in single setting

f) Time taken to reach vulcanising temperature of 145°C min

g) Min pressure on belt kg/sq.cm

h) Platens

   - shape
   - no of pairs of platens - material of
     construction

i) Size of each platen

j) Weight of each platen

k) Power consumed for platen

l) Plant voltage

m) Cross beam

   - type
   - no of pairs of cross beam - materials of
     construction - size

n) Control panels

i. Quantity

ii. Protection class

iii. Mode of operation
o) Hand pump
   - Quantity
   - length
   - max pressure in kg/sq.cm

p) Hydraulic Hoses
   - Quantity
   - length
   - max pressure kg/sq.cm

q) Distributor block
   - Quantity
   -- no of compartments
   -- list of fittings

r) Thermometers
   - Quantity
   -- Range,type
   -- Type

s) Accessories
   -- Handles nos
   - Edge clamps nos
   - Edge bars nos
   - End spanners nos
   - T-torque wrench nos

2.32. Fire fighting equipment
   I) Type of pump
   II) Size of pump
   III) Motor rating
   IV) Capacity
   V) Head
   VI) Literature

2.32.1 Hoses
   i) No of hoses

2.33.0 Plough feeder
2.33.1 Diameter of plough
2.33.2 RPM of plough
2.33.3 Motor rating in kw
2.33.4 Motor rpm
2.33.5 Capacity
2.33.6 Dust extraction details
2.33.7 Cable feeding details
2.33.8 Variation in capacity achievable
2.33.9 Operating voltage
2.33.10 Length of travel
2.33.11 Number of blades
TECHNICAL INFORMATION TO BE SUPPLIED BY THE BIDDER

1.0 The Bidders are required to furnish all the necessary information as may be required in respect of electrical system to appreciate their offers in terms of specific requirements given in tender document and also as per their tender specifications suitimg to the Purchasers specific requirement failing which their offer may be treated as incomplete and passed over. These information inter-alia shall include the following:

1.1 **System Description**:
Detail description of the Electrical supply, distribution and control system including earthing system indicating various functions and facilities being furnished shall be elaborated. The details provided shall be in line with the technical requirements of the supply system as elaborated in the tender document elsewhere.

1.2 **Scope of Work**:
The tenderers are required to indicate their scope of work under the tender in clear terms.

1.3 **Equipment Details**:
In respect of all the electrical/electronics equipment the Bidders shall have to furnish their full technical details covering make, type, size, quantity, performance, parameters, specific technical features, descriptive pamphlets, past experience of equipment and place of installation, Civil/Structural specification etc. In particular the following equipment wise details shall be furnished:

1.3.1 **6600 V INDOOR SWITCHBOARD COMPRISING OF VACUUM CIRCUIT BREAKER & VACUUM CONTACTOR PANEL**:

I. **VACUUM CIRCUIT BREAKERS**
1) Make :
2) Rated Voltage :
3) Highest System Voltage :
4) No. of Poles :
5) Frequency :
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<td>7) Rated Current at Standard Ambient Temp.</td>
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<td>8) Symmetrical Breaking Capacity</td>
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<td>9) Making Capacity</td>
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<td>10) Short time current for 1 Sec.</td>
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<td>10) CPRI Certificate Number</td>
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<td>11) Impulse withstand voltage std. 1.2/50 micro sec. : wave</td>
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<td>12) Power frequency withstand voltage for 1 minute</td>
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<td>13) Opening time</td>
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<td>14) <strong>Interrupter</strong></td>
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<tr>
<td>a) Interrupter type</td>
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<tr>
<td>b) Make</td>
<td></td>
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<tr>
<td>c) Contact stroke</td>
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<td>d) Type of contacts</td>
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<td>e) Material of contact</td>
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<td>f) Shelf time</td>
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<td>g) Contact life</td>
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<td>i) At No load</td>
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<td>ii) At Normal current (up to rated current)</td>
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<td>iii) At Symmetrical short circuit current</td>
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<td>iv) Protections provided (Overload/Earth leakage/Instantaneous/ under voltage etc.)</td>
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<tr>
<td>15) <strong>Operating Mechanism</strong></td>
<td></td>
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<tr>
<td>a) Type (Motor/Solenoid/ManualMotor and : Manual)</td>
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<td>b) Trip free or fixed trip</td>
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<td>c) Charging time for motorised mech.</td>
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<td>d) Coil Voltage (Closing coil/Shunt trip coil)</td>
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<td>e) Trip/Close coil power</td>
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<td>f) Motor operating voltage</td>
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<td>g) Power required by charging motor</td>
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<td>h) Designed to close and latch or fitted with make current release</td>
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<tr>
<td>i) Auxiliary contact</td>
<td></td>
</tr>
<tr>
<td>i) No. of auxiliary contacts</td>
<td></td>
</tr>
<tr>
<td>ii) Breaking Capacity of auxiliary contacts</td>
<td></td>
</tr>
<tr>
<td>iii) Type</td>
<td></td>
</tr>
<tr>
<td>j) Mechanical operation counter</td>
<td></td>
</tr>
<tr>
<td>k) Vacuum Pressure</td>
<td></td>
</tr>
<tr>
<td>l) Capacitor switching current</td>
<td></td>
</tr>
<tr>
<td>16) IS Code No.</td>
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</table>

**II. PANEL**

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<table>
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<tbody>
<tr>
<td>a) Typical Dimensions L x B x H</td>
<td></td>
</tr>
<tr>
<td>b) Approx. weight</td>
<td></td>
</tr>
<tr>
<td>c) Sheet steel thickness</td>
<td></td>
</tr>
<tr>
<td>d) Test position</td>
<td></td>
</tr>
<tr>
<td>e) Indications on panel</td>
<td></td>
</tr>
</tbody>
</table>
f) Meters on panel : 

h) Bus bar rating (Horizontal) : 
i) Bus bar rating (Vertical) : 
j) Fault withstand capacity 1 sec. : 
k) Cable entry type : 
l) Front type : 
m) IS Code No & protection of enclosure : 

III. VACUUM CONTACTOR PANEL

a) Type (Drawout/Non-drawout) : 
b) Name of Markers : 
c) Number of Panels : 
d) Size of individual panel : 
i) Length : 
ii) Breadth : 
iii) Height : 
e) Life of contacts : i) Electrical : ii) Mechanical : 
f) Types of built-in protection : 
g) Arrangement for the surge suppressor in the : panel 
h) Type of material provided : 
i) Type of Indication Lamps : 
j) Technical & Operational details : 

IV. Any other additional facilities/instrument/protection provided over and above those mentioned in NIT.

1.3.2 MOTOR CONTROL CENTRE (MCC- I, II, III)

(FURNISH DETAILS SEPARATELY) :

1) Type (Single/Double front) : 
2) Fault level : 
3) Capacity of Horizontal busbars : 
4) Capacity of Vertical busbars : 
5) Size of Horizontal busbars :
<p>| | |</p>
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<tbody>
<tr>
<td>6)</td>
<td>Size of Vertical busbars :</td>
</tr>
<tr>
<td>7)</td>
<td>Material of the busbars :</td>
</tr>
<tr>
<td>8)</td>
<td>Size of the MCC :</td>
</tr>
<tr>
<td>a)</td>
<td>Length :</td>
</tr>
<tr>
<td>b)</td>
<td>Breadth :</td>
</tr>
<tr>
<td>c)</td>
<td>Height :</td>
</tr>
<tr>
<td>9)</td>
<td>Whether fully drawout type or otherwise :</td>
</tr>
<tr>
<td>10)</td>
<td>Number of feeders in MCC :</td>
</tr>
<tr>
<td>11)</td>
<td>Make of MCC</td>
</tr>
<tr>
<td>12)</td>
<td>Material for Male &amp; Female part of power : contacts</td>
</tr>
<tr>
<td>13)</td>
<td>Make of MCC</td>
</tr>
<tr>
<td>14)</td>
<td>Material for Anti-Tracking Barriers :</td>
</tr>
<tr>
<td>15)</td>
<td>Material for busbar shrouding :</td>
</tr>
<tr>
<td>16)</td>
<td>Rating of control contacts :</td>
</tr>
<tr>
<td>17)</td>
<td>Number of spare feeders (cubicles) with rating :</td>
</tr>
</tbody>
</table>

### 1.3.3 CONTROL CONSOLE AT SWITCHING STATION AND RAPID LOADING COMPLEX (FURNISH DETAILS SEPARATELY) :  

- **1)** Type of control (Electromechanical /Solid) :  
- **2)** Colour code of Push Buttons :  
- **3)** Colour code of Indication Lamps :  
- **4)** Make of Control equipment/System :  
- **5)** Size of control desk :  
- **6)** Whether with audio visual annunciation or not :  

### 1.3.4 MIMIC PANEL AT SWITCHING STATION AND RAPID LOADING COMPLEX (FURNISH DETAILS SEPARATELY) :  

- **1)** Whether Continuously illuminated or Spot illuminated :  
- **2)** Type of Annunciator, Whether Solid state or : other  
- **3)** Make of Mimic Panel :  

### 1.3.5 AIR CIRCUIT BREAKER :  

- **1)** Make :  
- **2)** Rated Voltage :  
- **3)** Highest System Voltage :  
- **4)** No. of Poles :  
- **5)** Frequency :  
- **6)** Rated Current at Standard Ambient Temp. :  
- **7)** Symmetrical Breaking Capacity :  
- **8)** Making Capacity :  
- **9)** Short time current for 1 Sec. :  
- **10)** CPRI Certificate number :
11) Impulse withstand voltage std.1.2/50 micro sec.:
   wave
12) Power frequency withstand voltage for 1 minute:
13) Opening time:
14) Type (Drawout/Non-drawout):
15) Type of protection envisaged:
16) Maximum frequency of operation per hour:
17) Mechanical life:
18) Weight:
19) Type of releases envisaged:
20) **Interrupter**
   a) Interrupter type:
   b) Make:
   c) Contact stroke:
   d) Type of contacts:
   e) Material of main contact:
   f) Arcing contacts:
   g) Shelf time:
   h) Contact life
      i) at No load:
      ii) at Normal current (up to rated current):
      iii) at Symmetrical short circuit current:
21) **Operating Mechanism**
   a) Type:
   b) Trip free or fixed trip:
   c) Charging time for motorised mech.:
   d) Coil Voltage (Closing coil/Shunt trip coil):
   e) Trip/Close coil power:
   f) Motor operating voltage:
   g) Power required by charging motor:
   h) Designed to close and latch or fitted with make:
      current release
      i) Auxiliary contact:
      ii) No. of auxiliary contacts No + NC:
      iii) Breaking Capacity of auxiliary contacts:
      iv) Type:
   j) Mechanical operation counter:
   k) Protection provided (Overload/Earth:
      leakage/instantaneous/undervoltage etc.):
22) IS Code No:
23) **Panel**
   a) Typical Dimensions L x B x H:
   b) Approx. weight:
   c) Sheet steel thickness:
   d) Test position:
   e) Bus bar system:
   f) Horizontal bus
g) Vertical bus
h) Fault withstand capacity - 1 sec.
i) Cable entry
j) Bus duct
k) Type of front
l) Sheet steel thickness
m) Test position
n) Indications on panel
o) Meters on panel
p) IS Code No & protection of enclosure
q) Details of any other additional:
   facility/instruments/protection provided over and above those mentioned

1.3.6 **Switch fuse unit:**

<table>
<thead>
<tr>
<th>a) Make</th>
<th>:</th>
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<tbody>
<tr>
<td>i) Location</td>
<td>:</td>
</tr>
<tr>
<td>ii) Quantity</td>
<td>:</td>
</tr>
<tr>
<td>iii) Rated Current</td>
<td>:</td>
</tr>
<tr>
<td>iv) Rated Voltage</td>
<td>:</td>
</tr>
<tr>
<td>v) Short time rating</td>
<td>:</td>
</tr>
<tr>
<td>b) Fuses</td>
<td>:</td>
</tr>
<tr>
<td>i) Make</td>
<td>:</td>
</tr>
<tr>
<td>ii) Type (HRC)</td>
<td>:</td>
</tr>
<tr>
<td>iii) Rated Current</td>
<td>:</td>
</tr>
<tr>
<td>iv) Quantity (Current rating wise)</td>
<td>:</td>
</tr>
<tr>
<td>v) Rupturing capacity</td>
<td>:</td>
</tr>
<tr>
<td>vi) Rated Voltage</td>
<td>:</td>
</tr>
<tr>
<td>vii) Current carrying capacity for 0.12 sec &amp; 1 sec.</td>
<td>:</td>
</tr>
<tr>
<td>c) Dimensions of switch fuse unit</td>
<td>:</td>
</tr>
<tr>
<td>d) Weight of switch fuse unit</td>
<td>:</td>
</tr>
<tr>
<td>e) IS Code No &amp; protection of enclosure</td>
<td>:</td>
</tr>
</tbody>
</table>

1.3.7 **MOULDED CASE CIRCUIT BREAKER IN FIXED EXECUTION:**

| 1) Make | : |
| 2) Rated Voltage | : |
| 3) Highest System Voltage | : |
| 4) No. of Poles | : |
| 5) Frequency | : |
| 6) Rated Current at Standard Ambient Temperature | : |
| 7) Symmetrical Breaking Capacity | : |
| 8) Making Capacity | : |
| 9) Short time current for 1 Sec. | : |
### MINIATURE/RESIDUAL CURRENT CIRCUIT DISTRIBUTION BOARDS:

1. Type
2. Nominal System Voltage
3. Highest System Voltage
4. No. of Poles + N for Incoming
5. Frequency
6. Normal Current Rating of circuit breaker at Standard Ambient
7. Symmetrical Breaking Capacity
8. Short time current for 1 Sec.
9. Power frequency withstand voltage for 1 minute

### BREAKERS

10. Approx. weight
11. Typical Dimensions L x B x H of Distribution Board
12. Number of Outgoings TP + N
13. Number of Outgoings SP + N
14. Type of protection envisaged (Overload/Instantaneous/Earth leakage etc.)
15. Earth leakage current for tripping in mA
16. Bus Rating
17. Mounting
18. Array of Breakers
19. Padlocking facility
20. Body earthing screw
21. Cable termination arrangement
22. Mechanical life
23. Standards to conform
24. Make
### 1.3.9 LIGHTING:

1) Type of Luminaries in different locations
2) Illumination Level (LUX) envisaged in different location giving reference of any standards, if any
3) Watts corresponding to type of lamps
4) Type of enclosure for outdoor lighting
5) Type of Flameproof enclosure
6) Make of Luminaries
7) Approx. quantity of different type of luminaries

### 1.3.10 SWITCHBOARDS FOR LIGHTING CIRCUITS:

1) Rated Voltage
2) No of 5A double pole MCBs switches
3) No of 5/15A, 3/5 pin sockets with 15A switches
4) No of fan regulators (electronic)
5) Rewirable fuse 5A with base
6) Top cover of the board
7) Switch board
8) Internal wiring
9) Mounting
10) Earthing

### 1.3.11 EARTHING:

1) No. of earth pits envisaged
2) Type of material of down conductors
3) Type & material of earth conductors
4) Type & Material of earth electrodes
5) Whether separate earthing has been considered for lightning protection or not
6) Quantity of Material & Weight
1.311.1 OVER HEAD TRANSMISSION
LINE(Ref.proposed route drawing no.RI-2/E&M/200032)

1. Detail design & drawing of OHT line inclusive of

i) Total no. of single pole structures

ii) Total no. of Double pole structures

iii) Total no. of Four pole structures

iv) Type & size of conductor & length in Km

v) Type & nos. of Disc & Pin insulators

vi) Earthing system & no. of earth pits

vii) Type & nos.of stay sets

viii) No.of horizontal type load Isolator

ix) Type & nos.of lightening arrestor

x) Length & size of cradle guard wire

xi) Anti climbing arrangement

xii) Quantity of iron materials & its weight

xiii) Quantity of civil materials for RCC foundation
1.3.12 **CABLES:**

1) Type & size of power cables with Voltage grades
2) Type & size of lighting cables with voltage grades
3) Type & size of control cables with voltage grades
4) Make of Power Cables
5) Make of Lighting Cables
6) Make of Control Cables
7) Quantity (Size - wise) of power cable
8) Quantity (size-wise) of Lighting Cable
9) Quantity (size-wise) of control cables

1.3.13 **MOTORS (HT)**

1) Type of Motors
2) Degree of protection envisaged for motors
3) Number of 3 phase HT Motors
4) Standards to which motors conform to
5) Insulation Class
6) Make of the Motors
7) Type & Make of Relays to be provided for the protection of the motors

1.3.14 **MOTORS (LT)**

1) Type of Motors
2) Degree of protection envisaged for motors
3) Number of 3 phase LT Motors
4) Standards to which motors conform to
5) Insulation Class
6) Make of the Motors
7) Type & Make of Relays to be provided for the protection of the motors
8) No. of Starts I) Cold, ii) Hot

1.3.15 **MOTORS (SINGLE PHASE)**

1) Type of Motors
2) Degree of protection envisaged for motors
3) Number of single phase Motors
4) Standards to which motors conform to
5) Insulation Class
6) Make of the Motors
7) Type & Make of Relays to be provided for the protection of the motors
8) No. of Starts I) Cold, ii) Hot

1.3.16 **TRANSFORMERS** :

1) Name of the Manufacturer :
2) Service :
3) Rating :
   a) Rated KVA :
   b) Rated Voltage of HV :
   c) Rated Voltage of LV :
   d) Temperature rise in oil :
   e) Temperature rise by resistance of windings :
4) Number of phases :
5) **Connections** :
   a) High Voltage :
   b) Low Voltage :
   c) Vector group reference :
6) **Tappings** :
   High Voltage :
7) No-load loss at rated voltage & frequency :
8) Load loss at rated current & frequency at 75°C :
9) Impedance at rated current & frequency at 75°C :
10) Reactance at rated current & frequency :
11) **Efficiencies at 75°C at Unity Power Factor** :
   a) At full load :
   b) At 3/4 full load :
   c) At 1/2 full load :
12) **Regulation at full load at 75°C At U P F** :
   a) At Unity Power Factor :
   b) At 0.8 power factor lagging :
13) No-load current at rated voltage & frequency :
14) **Approx. weights** :
   a) Core & windings :
   b) Tank & fittings :
   c) Oil :
   d) Total weight :
15) Approximate capacity of oil :
16) **Approx. overall dimension** :
   a) Length :
   b) Breadth :
   c) Height :
17) **Terminal Arrangement**
   a) High Voltage
   b) Low voltage

18) **Reference standard**

19) **Remarks**

### 1.3.16.1 ADDITIONAL TECHNICAL PARTICULARS

1) **Approximate max. flux density at rated voltage & frequency**

2) **Efficiencies at 75°C at 0.8 Power Factor lagging**
   a) At full load
   b) At 3/4 full load
   c) At 1/2 full load

3) **Load at which maximum efficiency occurs**

4) **Maximum efficiency**

5) **Impulse level with 1/50 micro second**

6) **Type of windings**
   a) High Voltage
   b) Low Voltage

7) **Insulation Material**
   a) Turn insulation high voltage
   b) Turn insulation Low voltage
   c) Insulation core to low voltage
   d) Insulation high voltage to low voltage

8) **Clearances**
   a) In oil
   b) Out of oil
   c) Minimum clearance high voltage to tank in oil

9) **Details of Tank**
   a) Approx. thickness of sides
   b) Approx. thickness of bottom
   c) Approx. thickness of cover
   d) Approx. thickness of tube radiators

10) **Minimum clearance height for lifting core & windings from tank**

11) **Shipping Details**
   a) Parts detached for transport
   b) Approx. dimensions of largest package
   i) Length
ii) Breadth

iii) Height

1.3.16.2 DETAILS OF BUSHING

1) Type
2) Momentary power frequency dry withstand voltage
3) Visible power frequency discharge voltage
4) One minute dry withstand power frequency voltage
5) One minute withstand power frequency voltage
6) Under oil flashover or puncture withstand power: frequency voltage
7) Full wave withstand impulse voltage
8) Under oil flashover or puncture withstand impulse: voltage
9) Creeping distance in air
10) Recommended gap setting
11) Weight of assembled bushing

1.3.16.3 DETAILS OF OFF-LOAD TAP CHANGING GEAR

1) Make
2) Type
3) Rating
   a) Rated Voltage
   b) Rated current
   c) Step voltage
   d) Number of steps
4) Control
5) Auxiliary supply details
6) Voltage control
7) Line drop compensation
8) Parallel operation
9) Protective devices
10) Approx. over weight
11) Approx. over dimensions
12) Approx. over quantity of oil.

1.3.17 CAPACITOR BANK (6.6 kV)

1) Installation
2) Rated Voltage
3) Frequency
4) Phases
5) Maximum service voltage
6) Rated output
7) Configuration
8) Discharge resistors
9) Earthing
10) Cable entry
11) Weight
12) Control voltage
13) P.F. Setting
14) Operation (Automatic/Manual)
15) Capacitor Losses
16) Total Losses, including accessories as contactors, discharge devices etc.
17) Type of Capacitors
18) Capacitor voltage tests
19) Ambient Temperature
   i) Maximum
   ii) Minimum
20) Case Material
21) Case thickness
22) Fixing
23) Protections
24) Standards
25) Make

1.3.18  MULTIPOINT DIGITAL TEMPERATURE SCANNER

1) No. of Channels
2) Temperature range
3) Resolution
4) A/D Converter
5) A/D Converter accuracy
6) Scanning speed
7) Display
8) Power supply
9) Dimensions
10) Mounting
11) Overall size
12) Panel cutout
13) Make

1.3.19  WELDING SYSTEM

1) Type
2) Make
3) No. of welding sets
   a) Motor Generator sets
   b) Transformer welding sets
4) Current range
5) Corresponding voltage
6) No. of output terminals/set
7) Built-in protection for welding sets
8) Type of protection for the operation
9) Max. permissible temperature rise of the welding sets

10) Continuous rating of MG Set

11) Continuous rating of Transformer welding Set

1.3.20 CENTRALISED REMOTE & SEQUENCE CONTROL AT RAPID LOADING COMPLEX

I) Control Desk, Annunciation Panels, Local Control Station

I.1 Control Desk

1) Whether General Arrangement drawing complete: with all dimensions details furnished

2) Make

3) Standard to which conforms

4) Mounting details

5) Type of enclosure

6) Thickness of sheet metal used for side walls, top & bottom covers, doors

7) Whether mimic panel included or not

8) Paint shade

9) Ground Box – Material, size, size of connector, fault current rating etc.

10) Internal wiring
    i) Voltage grade
    ii) Insulation
    iii) Conductor material
    iv) Size of potential & control circuit
    v) HV withstand rating of control wiring
    vi) Colour code

II) Control switch
    i) Make & Type
    ii) Standard to which conforms
    iii) Contact rating
    iv) Whether key interlock furnished

12) Push button
    i) Make & Type
    ii) Standard to which conforms
    iii) Number of contacts provided

13) Ammeter/Voltmeter Selector
### switch

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<td>i) Make &amp; Type</td>
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<tr>
<td></td>
<td>ii) Standard to which conforms</td>
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<td></td>
<td>iii) Contact rating</td>
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#### 14) Lamps

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<tr>
<td></td>
<td>ii) Standard to which conforms</td>
<td></td>
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<tr>
<td></td>
<td>iii) Rated voltage, Volts</td>
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<tr>
<td></td>
<td>iv) Rated Power, Watts</td>
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#### 15) Space Heaters

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<td>i) Make &amp; Type</td>
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<td></td>
<td>ii) Rated voltage, Volts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>iii) Rated Power, Watts</td>
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<td></td>
<td>iv) Mounting details</td>
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<td></td>
<td>v) Whether thermostat provided</td>
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#### 16) Terminal Blocks

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<td></td>
<td>ii) Standard to which conforms</td>
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</tr>
<tr>
<td></td>
<td>iii) Rated voltage, Volts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>iv) Rated Current, Amps</td>
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<tr>
<td></td>
<td>v) Copper cable size</td>
<td></td>
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<td></td>
<td>vi) Whether 20% spare terminals provided</td>
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</table>

#### 17) Instruments & Meters

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<tbody>
<tr>
<td></td>
<td>i) Make &amp; Type</td>
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<tr>
<td></td>
<td>ii) Standard to which conforms</td>
<td></td>
</tr>
<tr>
<td></td>
<td>iii) Range</td>
<td></td>
</tr>
<tr>
<td></td>
<td>iv) Rated voltage, Volts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>v) Instrument accuracy class</td>
<td></td>
</tr>
<tr>
<td></td>
<td>vi) Mounting details</td>
<td></td>
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</tbody>
</table>

#### 18) Facilities provided on the control desk as per specification (List to be furnished)

### 1.2 Annunciation Panel

<p>| | |</p>
<table>
<thead>
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<tbody>
<tr>
<td>1) Make</td>
<td></td>
</tr>
<tr>
<td>2) Type of annunciation system</td>
<td></td>
</tr>
<tr>
<td>3) Number of windows</td>
<td></td>
</tr>
<tr>
<td>4) Type of panel construction</td>
<td></td>
</tr>
<tr>
<td>5) Material &amp; thickness</td>
<td></td>
</tr>
<tr>
<td>6) Dimension</td>
<td></td>
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<tr>
<td>7) Any other special feature</td>
<td></td>
</tr>
<tr>
<td>8) Whether write-up with description of system</td>
<td></td>
</tr>
</tbody>
</table>
I.3  Programmable Logic Controller

A) Central Processing Unit (CPU) subsystem:
   comprising Power supply, Processor & Memory
   a) Power supply : 
   b) Processor :
      i) Word size : 
      ii) Scan time : 
      iii) I/O Scan time : 
      iv) I/O Capacity : 
      v) Transfer time : 
      vi) Memory capacity : 
   vii) System response : 

B) Input/Output sub system
   a) Chasis with power supply :
   b) I/O count & distribution 
      (Inclusive of more than 10% : spares)
      i) Analog input (4 to 20 mA DC) : 
      ii) Analog output (4 to 20 mA DC) : 
      iii) Digital input (Potential free contacts) : 
      iv) Digital output (Potential free contacts) : 
   c) Type of I/O modules:
   d)Capacity per module 
      i) Analog input (4 to 20 mA DC) : 
      ii) Analog output (4 to 20 mA DC) : 
      iii) Digital input (Potential free contacts) : 
      iv) Digital output (Potential free contacts) : 
   e) Expansion chasis for housing I/O modules : 
   f) CPU rack along with local I/Os : 
   g) Remote I/O stations : 
   h) I/O status indication : 

C) Console sub system
   a) Operator station (Nos. & function) : 
   b) Programming station (Nos. & function) : 

: furnished
c) Personal computer with printer (Nos. & function)

D) **Communication sub system**
   a) Between processor & I/O subsystem :
   b) Communication module (location and features) :
   c) Between Processor & console :
   d) Communication port in CPU (location and features) :
   e) Networking hardware :
      i) I/O bus cable :
      ii) Switching devices with ports :
      iii) Console bus cable :
      iv) For Communication between processor & each power analyzers & VFD for apron feeders if any
   v) Necessary slave interfaces/protocols, if any :

E) **Software Packages**
   a) For operator station & mimic station :
   b) For Programming station and laptop computer :

F) **UPS system with cabinet**

G) **Computer mimic & VDU (Location & Features)**

H) **Laptop computer** for reloading software in PLC/PC) : Quantity & Configuration

**Panels/Cabinets**
   a) For housing CPU rack with local I/Os & Power distribution accessories : features, quantity
   b) For housing remote I/O racks & Power distribution accessories : features, quantity
   c) Fabrication material & cabinet finish :
   d) Enclosure protection class :
   e) Inside cable wiring : size, type :
   f) Illumination of panels : features :

II. **LOCAL CONTROL STATION**

1) Make :
2) Type :
3) Standard to which conforms :
4) Degree of enclosure protection :
5) Material & thickness
6) Facilities provided : 
7) No. of regulating stages : 
8) Provision of zero voltage relay : 
9) Any other special features : 
10) Details of automatic On/Off device : 

1.3.21 LEADCELL

1) Non-linear (maximum) : 
2) Repeatability (maximum) : 
3) Hysteresis (maximum) : 
4) Creep (maximum) : 
5) Temperature effect on rated output : 
6) Zero balance : 
7) Temperature effect on zero balance : 
8) Over load rating, safe : 
9) Over load rating, ultimate : 
10) Insulation resistance : 
11) Electrical excitation : 
12) Rated output : 
13) If imported, whether suitable for Indian condition : 
14) Make : 

1.3.22 SAMPLING

1) Whether separate control console & mimic panel for : sampler provided or it is controlled by central control console 
2) Whether sampler can be controlled independently, if : required
### 1.3.23 INVERTER SET FOR EMERGENCY LIGHTS

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1</td>
<td>Type</td>
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<td>2</td>
<td>Make</td>
</tr>
<tr>
<td>3</td>
<td>Rated kVA</td>
</tr>
<tr>
<td>4</td>
<td>Rated Voltage, Volts</td>
</tr>
<tr>
<td>5</td>
<td>No. of phases</td>
</tr>
<tr>
<td>6</td>
<td>Frequency</td>
</tr>
<tr>
<td>7</td>
<td>Current in Amps</td>
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<tr>
<td>8</td>
<td>Whether automatic switching on facility provided in case of power failure</td>
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</table>

### 1.3.24 PRESSURISATION & AIR CONDITIONING

**A) Pressurisation**

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<tr>
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<tr>
<td>2</td>
<td>Pressure</td>
</tr>
<tr>
<td>3</td>
<td>Temperature</td>
</tr>
<tr>
<td>4</td>
<td>No. of air changes</td>
</tr>
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<td>5</td>
<td>Other details</td>
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**B) Air Conditioning**

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<td>3</td>
<td>Temperature</td>
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<tr>
<td>4</td>
<td>Humidity</td>
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<tr>
<td>5</td>
<td>Other details</td>
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</table>
DATA SHEET (CIVIL)

SUB-SECTION-7.5.3 TECHNICAL INFORMATION TO BE SUPPLIED BY BIDDER

1.0 Design

No sub soil data are being provided with the tender documents. Soil investigation will be carried out before design engineering by the successful tenderer. However, for bidding purposes the tenderer should inspect the site before hand and assess the soil characteristics and its bearing capacity before quoting their rates as per standard practice.

a. Whether loads for design as per IS code be followed
b. Whether loads due to erection and surcharge due to movement of rail wagons & dumpers etc. be considered
c. Whether dynamic forces in machine foundation be considered
d. Whether blasting effect due to mining operation be considered
e. Whether measures will be taken in designing the structure falling in coal bed, against fire hazards.
f. Whether impact allowance considered due to the following-
   i. Crusher
   ii. Belt conveyor
   iii. Lifting device
   iv. Moving dumpers
g. Whether weep holes at suitable spacing with adequate boulder or gravel packing, moun will be provided for earth retaining structures.
h. Minimum walkway provided around the equipment.
i. Width of walkway provided in conveyor gallery for conveyor
j. Clear height of gallery provided
k. Size of conveyor tunnel

1.1 Construction

a. Whether site shall be cleared off all the obstructions before start of work by the tenderer.
b. Whether chemical testing of construction water for corrosive action of chemicals and other deleterious materials be done to render it fit for construction use.
c. Whether pre-construction anti-termite treatment to be done wherever necessary
d. Whether dewatering due to natural cause during construction be carried out at no extra cost.
e. Whether excavation will be carried out in all kinds of soil and rock including all lift and lead

f. Whether surplus excavated earth will be disposed off, at a distance of 2000 m from working area.

g. During excavation, will be the sides be protected by timber shoring, and shuttering wherever required.

h. Whether all materials used for construction shall conform to IS code

i. Will earth filling be done with good quality earth in layers not exceeding 150 mm thick and earth layers be compacted properly

j. Slope of earth fill

k. Whether brickwork will be carried out as per IS code of practice

l. Type of reinforcement steel to be used

m. Whether arrangement for testing of concrete and construction materials be done

n. Type and details of weigh batching equipment to be used.

o. Details of scheme for curing the concrete at high level

p. Details for storage facility for steel and cement

q. Whether fabrication and erection will be done as per relevant IS code.

r. Details of residential facilities to be provided for workman under ministry of labour statutory including water and electricity

s. Whether wind ties for the sheeting work to be provided

1.2 **Details of Specific Area**

1. **Receiving pit complex**
   a. Type of foundation for receiving pit structures
   b. Type of flooring to be provided
   c. Type of lining to be provided in receiving pit hopper and crushing box

II. **Crusher House**
   a. Whether foundation will be kept separate from rest of structure
   b. Type and minimum width of walkway around the equipment

III. **Ground bunker**
   a. Type of foundation
   b. Type of liner to be provided in the sloping portion
   c. Type of anchorage for supporting plough feeder rails

IV. **Conveyor Gantry for single and double conveyor**
   a. Size of conveyor gallery
   b. Width of walkway
c. Material used for walkway
d. Type of roof of conveyor gallery

V. **Trestle Type**
   a. RCC
   b. Steel

VI. **Underground Tunnel**
   a. Shape and size of tunnel
   b. Width of walkway

VII. **Roof and side cladding**
If roof and side cladding of conveyor gallery drive house and transfer station be of 22 gauge and 24 gauge CGI sheet respectively.

VIII. **Service Building**
   a. List of various service building
   b. Details of plinth area and height
   c. Type of construction
   d. Type of flooring

IX. **Water Supply**
Quantity of water envisaged for potable, industrial, fire fighting, dust suppression and extraction purposes.

X. **Number of tanks and their capacities**
   a. On ground in cu m
   b. Over ground in cu m

XI. **Road, Pavement and fencing**
   a. Type of pavement envisaged for dumper movement
   b. Crust thickness as provided in case of flexible pavement for movement of dumpers.
   c. Type of road in plant area for movement of men and materials along with crust thickness
   d. Length and height of protective boundary wall fencing

XII. **Site clearance**
Whether site shall be cleared of all debris and made suitable for use after completion of work.

Civil& structural:
Foundations:
   a) assumed bearing capacity
   b) assumed ground water table
   c) depth of foundation
   d) type of foundation envisaged
   e) grade of concrete being used in foundation pavement:
a) Type of pavement
b) Area of pavement
c) Type of drainage control & M.C.C Room:
d) Size of control room
e) Size of M.C.C Room
f) Size of toilet
g) Size of rooms to house suppressant tank and pumps, compressor, gas and oil cylinders, power packs etc

Super structure of silo:
a) grades of concrete
b) Type & grade of steel
c) type of filler in hopper portion if supported on horizontal slab thickness and grade of concrete in the layer on hopper portion between liners and fillers material.
d) Preliminary architectural drawing with isometric view of the super structure showing complete colour scheme(to be submitted with the tender)
f) Details of procedure of ferrosite lining on vertical wall

Incoming conveyor’s floors & platforms
a) overall size of floors
b) Minimum clearances for walkway and platforms around equipment
c) size and details of stairs
d) Numbers of monorails and beams with capacity.

Construction:
a) Type & details of weigh batching equipment to be used.
b) Type & material of staging and scaffolding.
c) Type & materials of shuttering (slip form/ jip form)
d) Details of lifting equipment for concrete and other building materials at height/levels.
e) Details of scheme for curing the concrete of high levels.
f) Details of pumps required for curing of concrete at high levels.
g) Details of facilities being provided at site for testing of construction materials.
h) Details of storage facilities to be provided for:
   - Cement
   - Steel
h) Details of facilities provided for construction of workmen under Ministry of Labour Statute.
TOTAL QUANTITIES OF DIFFERENT ITEMS OF CIVIL & STRUCTURAL WORKS ENVISAGED TO BE GIVEN BY T E N D E R E R:

a) Concrete - M 30
b) Concrete - M 25
c) Concrete - M 20
d) Concrete - M 15
e) Concrete (1:3:6) - M 10
f) Concrete (1:4:8) -
g) Cement requirement-
h) Reinforcement steel
i) Structural steel works including weight of GGI sheets
j) Area of CGI Sheetings
k) Excavation in all kinds of soil
l) Total length of piles
m) Diameter of piles
n) Brickwork
o) Exterior surface painting by SNOWCEM or equivalent cement based paint.
p) Interior painting by Emulsion paints
q) Any other major item of works

ii) Foundation Up to Ground Levels of Second Silo
SUB-SECTION 7.5.4
DATA SHEET FIRE FIGHTING

TECHNICAL INFORMATION TO BE FURNISHED BY THE BIDDER

In respect the of all the mechanical / electrical /electronics equipment the bidder shall have to furnish their full technical details covering make, type, size, quantity, performance parameters, specific technical features, descriptive pamphlets, past performance of equipment, place of installation, civil / structural specifications etc. required along with the offer failing which the offer may be treated as incomplete and passed over.

1.0 MECHANICAL

1.1 FIRE FIGHTING PUMPS

a) Code designation of pump

b) Type of Pump giving number of stages and type of suction

c) Suction flange connection

d) Delivery flange connection

e) Max. permissible total suction lift metre

f) Type of casing

g) Type of impeller

h) Type of fittings Standard fitted
1.2 Motors

a) Make
b) Quantity

c) Frame size

d) Type of enclosure

e) Type of mounting

f) Motor rating at 40 °C ambient temperature

g) Derating at 500 °C ambient temperature (kW)

h) Rated voltage

i) Full load current at rated voltage and frequency

j) Power factor at rated load and no load

k) Insulation class and type

l) Space heater provided, if yes, mention the following:
   - Number
   - Location
   - Power requirement

m) Weight
## PRIME MOVER

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<tr>
<td><strong>a)</strong></td>
<td>No. and arrangements of cylinders</td>
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<tr>
<td><strong>b)</strong></td>
<td>Aspiration</td>
</tr>
<tr>
<td><strong>c)</strong></td>
<td>Cooling</td>
</tr>
<tr>
<td><strong>d)</strong></td>
<td>Engine cylinder bore x Piston stroke</td>
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<tr>
<td><strong>e)</strong></td>
<td>Compression ratio</td>
</tr>
<tr>
<td><strong>f)</strong></td>
<td>Engine speed, MCR</td>
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<tr>
<td><strong>g)</strong></td>
<td>Displacement</td>
</tr>
<tr>
<td><strong>h)</strong></td>
<td>Governing</td>
</tr>
<tr>
<td><strong>i)</strong></td>
<td>Direction of rotation (from flywheel end)</td>
</tr>
<tr>
<td><strong>j)</strong></td>
<td>Max. continuous rating of engine</td>
</tr>
<tr>
<td><strong>k)</strong></td>
<td>Power consumed by radiator fan</td>
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## FUEL OIL DATA

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<tbody>
<tr>
<td><strong>i)</strong></td>
<td>Specific oil consumption</td>
</tr>
<tr>
<td><strong>ii)</strong></td>
<td>Fuel consumption (MCR)</td>
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<tr>
<td>- Full load</td>
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<tr>
<td>- Half load</td>
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</table>
i) Fuel tank capacity

**LUBRICATION DATA**

i) Type of lubricating oil

ii) Lub. oil consumption ml/h

iii) Lub. oil pressure

iv) Lub. oil temperature °C

v) Type of lub. oil cooling

vi) Lub. Oil tank capacity

**INLET & EXHAUST AIR DATA**

i) Charge air pressure Bar

ii) Charge air temperature °C

iii) Mass flow kg/hr

iv) Volume flow Cum/h

v) Temp. after cylinder

**WEIGHT**

i) Engine (dry) without flywheel kg

ii) Flywheel kg

iii) Coupling kg

iv) Bed plate kg

1.4 **PIPING**

a) Type

b) Diameter

c) Thickness

d) Pipe material

e) Approx. length

f) Compliance with standards
g) Make

1.5 FITTINGS

a) Type of fittings provided
b) Compliance with standards

1.6 FLANGES

a) Type
b) Size
c) Material
d) Compliance with standard for bolt holes drilled
e) Make

1.7 VALVE

a) Type
b) Make
c) Rating
d) Material of construction
e) Compliance with standards
8 HYDRANT

VALVE
a) Type
b) Make
c) Quantity/location
d) Material of construction
e) Compliance with standards

1.9 HOSE CABINET

a) Material of construction
b) Size
c) Quantity/location
d) Length of hose in each cabinet & other items
e) Make

1.10 HOSES

a) Type/material of construction
b) Size
c) Quantity/location
d) Compliance with Standards
e) Make

1.11 BRANCH PIPE

a) Make
b) Quantity
c) Material of construction
d) Compliance with standards

1.12 **NOZZLES**

a) Make
b) Quantity
c) Material of construction
d) Compliance with standards

1.13 **PORTABLE FIRE EXTINGUISHER (CO2 Type)**

a) Make
b) Capacity
c) Quantity
d) Compliance with standards

1.14 **PORTABLE FIRE EXTINGUISHER (DCP TYPE)**

a) Make
b) Capacity
c) Quantity
d) Compliance with standards

2.0 **ELECTRICALS**

2.1 **PUMPS**

a) Type and make of switchgear
b) Type and make of starter
c) Rating of type of switchgear and starter
d) Protection provided with starter
e) Type/Size/Length of power and control cables

f) Make of power and control cables

### SECTION -8 LIST OF DRAWINGS

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<th>PLATE NO</th>
<th>SUBJECT</th>
<th>DRWING NO</th>
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<td>Contour Level for the layout along the line of conveyors</td>
<td>R-2/E&amp;M/200020</td>
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<td>Contour Line diagram at site of silo</td>
<td>R-2/E&amp;M/300020</td>
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<tr>
<td>3</td>
<td>3</td>
<td>System Drawing for silo loading arrangement</td>
<td>R-2/E&amp;M/300022</td>
</tr>
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<td>4</td>
<td>4</td>
<td>Part Network Diagram</td>
<td>R-2/E&amp;M/300023</td>
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<td>Railway Siding</td>
<td>R-2/E&amp;M/300024</td>
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<td>Flow sheet diagram at site of silo</td>
<td>R-2/E&amp;M/300025</td>
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<td>7</td>
<td>7</td>
<td>General arrangement drg.of sections of CHP</td>
<td>R-2/E&amp;M/300026</td>
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<td>Plan &amp; Sectional view silo capacity 4000 Te</td>
<td>R-2/E&amp;M/300027</td>
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<td>9</td>
<td>Plan &amp; Sectional Elevation of Ground Bunker Capacity 10000 Te</td>
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<td>10</td>
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<td>2 nos. Receiving pit bunker capacity 150 Te each</td>
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<td>11</td>
<td>Sectional View DD Bunker Capacity 4000 Te</td>
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<td>Single Line Electrical Lay out drg.</td>
<td>R-2/E&amp;M/000031</td>
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<td>Proposed route of 6.6 kv overhead transmission line for silo</td>
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<td>14</td>
<td>Lay out drawing for silo loading arrangement.</td>
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END OF TENDER DOCUMENT
SECTION – 5

PART-III

FORM FOR PRICE BID
## A. SURVEY, SOIL TESTING & DESIGN ENGINEERING COST

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<th>Sub-heads/ Item description</th>
<th>Quantum of works</th>
<th>Unit price</th>
<th>Amount</th>
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<tbody>
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<td>1</td>
<td>Detailed survey of the area with in the plant limit &amp; submission of reports</td>
<td>Complete works as per tender document</td>
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<tr>
<td>2</td>
<td>Sub-soil exploration, field and laboratory testing of samples and submission of Report</td>
<td>Complete works as per Tender Document</td>
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<tr>
<td>3</td>
<td>Design engineering cost</td>
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<tr>
<td>a)</td>
<td>G.A &amp; detailed engineering designs and drawings of all Civil and Structural included in system and scope of work</td>
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<tr>
<td>b)</td>
<td>Preparation of system engineering</td>
<td>As per system requirement</td>
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<td></td>
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<tr>
<td>c)</td>
<td>G.A. &amp; detailed engineering designs and drawings including working and maintenance manuals of</td>
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<tr>
<td></td>
<td>i) All individual equipment (Mechanical &amp; Electrical)</td>
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<td></td>
<td>ii) Dust control and pressurisation system</td>
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<td></td>
<td>iii) Fire fighting system</td>
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<td></td>
<td>iv) Chutes and liners</td>
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<td></td>
<td>v) Communication system</td>
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<td>vi) Illumination system</td>
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<td></td>
<td>vii) Plant control system</td>
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<td>viii) ......................................................</td>
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<td>Documentation as per tender specification</td>
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<td>5</td>
<td>Taxes, if any</td>
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### B. PRICE BREAK UP FOR CIVIL AND STRUCTURAL WORKS

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<th>Unit rate</th>
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<td>a.</td>
<td>DEVELOPMENT WORKS &amp; INFRASTRUCTURE</td>
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<tr>
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<td>Site Development</td>
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<td>2</td>
<td>Sewerage</td>
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<tr>
<td>3</td>
<td>Arboriculture</td>
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<tr>
<td>4</td>
<td>Water supply &amp; pipeline 150 mm dia</td>
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<tr>
<td>5</td>
<td>Pump House</td>
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<tr>
<td>6</td>
<td>Approach road</td>
<td></td>
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<tr>
<td>7</td>
<td>Sub-station building</td>
<td></td>
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<tr>
<td>8</td>
<td>Office, security office, first aid centre and tool room</td>
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<tr>
<td>9</td>
<td>Parking Shed</td>
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<tr>
<td>10</td>
<td>Lighting Tower</td>
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<tr>
<td>11</td>
<td>Underground reservoir</td>
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<tr>
<td>12</td>
<td>Internal road 3.75m wide</td>
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<tr>
<td>13</td>
<td>Pavement for receiving pit</td>
<td></td>
<td></td>
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<tr>
<td>14</td>
<td>culverts 1.22m span</td>
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<td>15</td>
<td>Drains with average size 30cmX 40cm</td>
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<tr>
<td>b.</td>
<td>CIVIL &amp; STRUCTURAL WORKS</td>
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<td>1</td>
<td>Earthwork in cutting receiving pit</td>
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<td>2</td>
<td>Earth work in ground bunker &amp; haul road diversion</td>
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<td>3</td>
<td>Earth work in cutting other items</td>
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<td>4</td>
<td>Earth work in filling</td>
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<td>Sand filling</td>
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<td>6</td>
<td>PCC at all levels as per system requirement</td>
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<td>a)</td>
<td>Mix - 1:2:4</td>
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</tr>
<tr>
<td>b)</td>
<td>Mix – 1:4:8</td>
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<td></td>
<td>RCC (excluding reinforcement)</td>
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<td>a)</td>
<td>M-20</td>
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<td>b)</td>
<td>M-25</td>
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<tr>
<td>7</td>
<td>Supply, bending, binding and placing of tor steel</td>
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<td>8</td>
<td>Supply, fabrication and erection of structural steel at all levels and as per Bidding Documents</td>
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<td>9</td>
<td>22/24 gauge CGI sheeting at all levels including supply</td>
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<td>Stainless steel liner as per requirement</td>
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<td>Ironite liner with epoxy as per requirement</td>
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<td>12</td>
<td>Railway Track</td>
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<tr>
<td>13</td>
<td>Misc. Items such as dewatering, shoring, water proofing, rock cutting, brick work etc.</td>
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<td>14</td>
<td>Taxes, if any</td>
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\[ \text{SUB-TOTAL OF 'B' = a+b+c+d} \]
### C. 1 PRICE BREAK UP OF PLANT & MACHINERY

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<th>Unit cost</th>
<th>Total cost</th>
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<tr>
<td>i</td>
<td>Rapid loading system (Silo 4000te)</td>
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<tr>
<td>ii</td>
<td>Preweigh hoppers,</td>
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<td>iii</td>
<td>Primary single roll crusher</td>
<td>No</td>
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<td>iv</td>
<td>Twin shaft coal sizer</td>
<td>No</td>
<td>2</td>
<td></td>
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<tr>
<td>v</td>
<td>Appron feeder</td>
<td>No</td>
<td>2</td>
<td></td>
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<tr>
<td>vi</td>
<td>Motorised Hoist</td>
<td>No</td>
<td>11</td>
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<tr>
<td>vii</td>
<td>Automatic Coal sampling system</td>
<td>No</td>
<td>1</td>
<td></td>
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<tr>
<td>viii</td>
<td>Plough feeder</td>
<td>No</td>
<td>4</td>
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<td>ix</td>
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<td>Metal detector</td>
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<td>Hydraulic Rock Breaker, 45 KW</td>
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<tr>
<td>xii</td>
<td>Grab 15 KW</td>
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<td>Chute assembly with liner</td>
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<td>Vibratory Feeder, 600 tph, 22Kw.</td>
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<td>xv</td>
<td>Safety &amp; fire fighting system and plant cleaning system</td>
<td>set</td>
<td>One</td>
<td>As required</td>
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<tr>
<td>xvi</td>
<td>Belt cleaning device</td>
<td>No</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>xvii</td>
<td>Belt pulling device</td>
<td>No</td>
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<tr>
<td>xviii</td>
<td>Dust suppression/extraction system with piping &amp; other accessories</td>
<td>Set</td>
<td>One</td>
<td>Complete</td>
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<td>Lift and ventilation at receiving section for crushers and others</td>
<td>LS</td>
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<td>As required</td>
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<td>Miscellaneous items like tools &amp; tackles, chain pulley blocks, belt vulcanising system grizzly etc.</td>
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<td>LS</td>
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<td>Belt conveyor C1, C2, C3 &amp; C4</td>
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<td>xxi</td>
<td>Beltling</td>
<td>Km</td>
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<td>xxiii</td>
<td>Any Other item if</td>
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Sub-Total (C.1.1)
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<th>Unit cost</th>
<th>Total cost</th>
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<td>i</td>
<td>Two nos 6.6 kV single circuit OHT line with ACSR ‘WOLF’ conductor, each 4 KM length and another single circuit OHT line with ACSR, WOLF conductor of 0.5 KM length</td>
<td>km</td>
<td>8.5</td>
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<td>ii</td>
<td>6.6 kV VCB complete with metering &amp; protection complete with 20 panel comprising 2 – Incoming 630 Amp, 150 MVA 18 – Outgoing 630 Amp, 150 MVA</td>
<td>Panel</td>
<td>1</td>
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<tr>
<td>iii</td>
<td>6.6 KV, 630 / 400 Amp A.B. Switch with DO fuse</td>
<td>Set</td>
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<td>iv</td>
<td>6.6 KV Lightening arrestor (each set of 3 units)</td>
<td>set</td>
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<td>v</td>
<td>6.6 kV 1272 kVar Capacitor bank</td>
<td>set</td>
<td>2</td>
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<td>vi</td>
<td>Power factor control panel</td>
<td>set</td>
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<tr>
<td>vii</td>
<td>1000 kVA, 6.6 / 0.44kV cu wound indoor type power transformer</td>
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<tr>
<td>viii</td>
<td>500 kVA, 6.6 / 0.44kV cu wound indoor type power transformer</td>
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<td>ix</td>
<td>200 kVA, 6.6 / 0.44kV cu wound indoor type power transformer</td>
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<td>6.6 KV, 630 Amp, 250 MVA Vacuum circuit breakers</td>
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<td>xi</td>
<td>440V Motor Control Centres (MCC) for supply of power to LT Motors</td>
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<td>xii</td>
<td>Control System</td>
<td>LS</td>
<td>As required</td>
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<tr>
<td>xiii</td>
<td>1.1/0.650 kV Control &amp; signaling cables</td>
<td>LS</td>
<td>As required</td>
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<tr>
<td>xiv</td>
<td>Earthing System</td>
<td>LS</td>
<td>As required</td>
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<tr>
<td>xv</td>
<td>Power &amp; Control cables of different rating &amp; sizes, 6.6 kV grade Power cables, 1.1 kV grade Power cables, 1.1 kV grade Lighting cables</td>
<td>LS</td>
<td>As required</td>
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<td></td>
<td>Item Description</td>
<td>Unit</td>
<td>Quantity</td>
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<td>xvi</td>
<td>Fire Fighting LS As</td>
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<tr>
<td>xvii</td>
<td>Cable trenches, soak pits etc. LS As required</td>
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<td>xviii</td>
<td>Welding system LS As</td>
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<tr>
<td>xix</td>
<td>Transformer welding set complete with cable and accessories LS As required</td>
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<td>xx</td>
<td>Motor generator welding set complete with cable and accessories LS As required</td>
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<td>xxi</td>
<td>Welding sockets complete with switches, holder set etc. LS As required</td>
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<tr>
<td>xxii</td>
<td>Welding cables LS As</td>
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<tr>
<td>xxiii</td>
<td>Testing equipment LS As</td>
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<td>xxiv</td>
<td>Telecommunication LS As</td>
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<td>xxv</td>
<td>Misc. (Illumination etc and others) LS As required</td>
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<tr>
<td>xxvi</td>
<td>230V(L-L) Main Lighting distribution boards LS As</td>
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<td>xxvii</td>
<td>230V(L-L) Lighting Distribution Boards LS As</td>
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<td>xxviii</td>
<td>Fluorescent fixtures complete with control gears accessories etc. LS As required</td>
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<td>xxix</td>
<td>High pressure sodium vapour lamps complete with control gears accessories etc. LS As required</td>
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<td>xxx</td>
<td>Street lighting poles/brackets LS As</td>
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<tr>
<td>xxxi</td>
<td>Junction boxes complete with fuse terminal block and other accessories LS As required</td>
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<td>DG sets for emergency light no 2</td>
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<td>Digital clock with accessories for automatic switching ON/OFF of street lights</td>
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<td>xxxiv</td>
<td>Any Other item if required LS As required</td>
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**Sub total (C 2.2)**

**Total C1.2 = C.1.1 + C.2.2**
### 3. SPARE PARTS

- Testing equipment (elect.)
- Mandatory spares for electrical
- Mandatory spares for mechanicals
- Recommended spares for Electrical
- Recommended spares for mechanicals

**Sub Total ‘C.1.3’:**

**Total of C.1 = C.1.1+C.1.2+C.1.3**
### C.2 ERECTION, INSTALLATION & COMMISSIONING OF PLANT & MACHINERY

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<tr>
<th>Sl. No.</th>
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<th>Qty</th>
<th>Unit cost</th>
<th>Total cost</th>
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<tr>
<td><strong>1</strong> MECHANICAL (List of equipment)</td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>i</td>
<td>Rapid loading system</td>
<td>set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ii</td>
<td>Preweigh hoppers</td>
<td>No</td>
<td>2</td>
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<td>iii</td>
<td>Primary single roll crusher</td>
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<tr>
<td>iv</td>
<td>Twin shaft coal sizer</td>
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<td>v</td>
<td>Apron feeder</td>
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<td>Motorised Hoist</td>
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<tr>
<td>vii</td>
<td>Automatic Coal sampling system</td>
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<td>Plough feeder</td>
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<td>Magnetic separator</td>
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<td>Metal detector</td>
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<td>xi</td>
<td>Hydraulic Rock Breaker, 45 KW</td>
<td>No</td>
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<tr>
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<td>Grab 15 KW</td>
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<td>xiii</td>
<td>Chute assembly with liner</td>
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<tr>
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<td>Vibratory Feeder, 600 tph, 22Kw.</td>
<td>No</td>
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<tr>
<td>xv</td>
<td>Safety &amp; fire fighting system and plant cleaning system</td>
<td>set</td>
<td>One</td>
<td>As required</td>
<td></td>
</tr>
<tr>
<td>xvi</td>
<td>Belt cleaning device</td>
<td>No</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>xvii</td>
<td>Belt pulling device</td>
<td>No</td>
<td>3</td>
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<tr>
<td>xviii</td>
<td>Dust suppression/exxtraction system with piping &amp; other accessories</td>
<td>Set</td>
<td>One</td>
<td>As required</td>
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<tr>
<td>xix</td>
<td>Lift and ventilation at receiving section for crushers and others</td>
<td>LS</td>
<td>LS</td>
<td>As required</td>
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<tr>
<td>xx</td>
<td>Miscellaneous items like tools &amp; tackles, chain pulley blocks, belt vulcanising system grizzly etc.</td>
<td>LS</td>
<td>LS</td>
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<td>Belt conveyor</td>
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<td>Belt conveyor</td>
<td>Km</td>
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<td>Any Other item</td>
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*Sub-Total(C.2.1)*

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<th><strong>2</strong> ELECTRICALS (list of equipment)</th>
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<td>i</td>
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<tr>
<td>Two nos 6.6 kV single circuit OHT line with ACSR ‘WOLF’ conductor of each length 4 KM and another single circuit OHT line with ACSR, WOLF conductor of length 0.5 KM</td>
<td>km</td>
<td>8.5</td>
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<td>ii</td>
<td></td>
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<tr>
<td>6.6 kV VCB complete with metering &amp; protection complete with 20 panel comprising 2 – Incoming 630 Amp, 150 MVA 18 – Outgoing 630 Amp, 150 MVA</td>
<td>Panel</td>
<td>1</td>
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<td>Description</td>
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<td></td>
<td></td>
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<tr>
<td>iii</td>
<td>6.6 KV, 630 / 400 Amp A.B. Switch with DO fuse</td>
<td>Set 6</td>
<td></td>
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</tr>
<tr>
<td>iv</td>
<td>6.6 KV Lightening arrester (each set of 3 units)</td>
<td>set 6</td>
<td></td>
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</tr>
<tr>
<td>v</td>
<td>6.6 kV 1272 kVar Capacitor bank</td>
<td>set 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>vi</td>
<td>Power factor control panel</td>
<td>set 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>vii</td>
<td>1000 kVA, 6/0.44kV cu wound indoor type power transformer</td>
<td>no 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>viii</td>
<td>500 kVA, 6/0.44kV cu wound indoor type power transformer</td>
<td>no 2</td>
<td></td>
<td></td>
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<tr>
<td>ix</td>
<td>200 kVA, 6/0.44kV cu wound indoor type power transformer</td>
<td>no 2</td>
<td></td>
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<tr>
<td>x</td>
<td>6.6 KV, 630 Amp, 250 MVA Vacuum circuit breakers</td>
<td>no 3</td>
<td></td>
<td></td>
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<tr>
<td>xi</td>
<td>440V Motor Control Centres (MCC) for supply of power to LT Motors</td>
<td>no 3</td>
<td></td>
<td></td>
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<tr>
<td>xii</td>
<td>Control System</td>
<td>LS As required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>xiii</td>
<td>1.1/0.650 kV Control &amp; signaling cables</td>
<td>LS As required</td>
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<td></td>
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<tr>
<td>xiv</td>
<td>Earthing System</td>
<td>LS As required</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Earthing strips / wires / conductors, ground electrodes, earthing pits etc.</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Lightning protection system for building and structures</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Equipment &amp; accessories for pressurization</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Air conditioners</td>
<td></td>
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<tr>
<td></td>
<td>Local control stations</td>
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</tr>
<tr>
<td></td>
<td>Voltage stabilisers for control circuits</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Computer and laptop</td>
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</tr>
<tr>
<td></td>
<td>Project Administrative Communication System with telephone sets</td>
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<tr>
<td></td>
<td>Industrial Duplex Loud Hailing Intercom System</td>
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<tr>
<td></td>
<td>Any other item</td>
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<td></td>
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</tr>
<tr>
<td>xv</td>
<td>Power &amp; Control cables of different rating &amp; sizes,</td>
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<tr>
<td></td>
<td>6.6 kV grade Power cables</td>
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</tr>
<tr>
<td></td>
<td>1.1 kV grade Power cables</td>
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<tr>
<td></td>
<td>1.1 kV grade Lighting cables</td>
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<tr>
<td>xvi</td>
<td>Fire Fighting</td>
<td>LS As required</td>
<td></td>
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</tr>
<tr>
<td>xvii</td>
<td>Cable trenches, soak pits etc.</td>
<td>LS As required</td>
<td></td>
<td></td>
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<tr>
<td>xviii</td>
<td>Welding system</td>
<td>LS As required</td>
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<td></td>
</tr>
<tr>
<td>xix</td>
<td>Transformer welding set complete with cable and accessories</td>
<td>LS As required</td>
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<tr>
<td>xx</td>
<td>Motor generator welding set complete with cable and accessories</td>
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<td>xxi</td>
<td>Welding sockets complete with switches, holder set etc.</td>
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<tr>
<td>xxii</td>
<td>Welding cables</td>
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<tr>
<td>xxiii</td>
<td>Testing equipment</td>
<td>LS As required</td>
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<tr>
<td>xxiv</td>
<td>Telecommunication</td>
<td>LS As required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>xxv</td>
<td>Misc. (Illumination etc and others)</td>
<td>LS</td>
<td>As required</td>
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</tr>
<tr>
<td>-----</td>
<td>-----------------------------------</td>
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<tr>
<td>xxvi</td>
<td>230V (L-L) Main Lighting distribution boards</td>
<td>LS</td>
<td>As required</td>
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<tr>
<td>xxvii</td>
<td>230V (L-L) Lighting Distribution Boards</td>
<td>LS</td>
<td>As required</td>
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<tr>
<td>xxviii</td>
<td>Fluorescent fixtures complete with control gears accessories etc.</td>
<td>LS</td>
<td>As required</td>
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<tr>
<td>xxix</td>
<td>High pressure sodium vapour lamps complete with control gears accessories etc.</td>
<td>LS</td>
<td>As required</td>
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<tr>
<td>xxx</td>
<td>Street lighting poles/brackets</td>
<td>LS</td>
<td>As required</td>
<td></td>
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<td>xxxi</td>
<td>Junction boxes complete with fuse terminal block and other accessories</td>
<td>LS</td>
<td>As required</td>
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<tr>
<td>xxxii</td>
<td>DG sets for emergency light</td>
<td>no</td>
<td>2</td>
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<tr>
<td>xxxiii</td>
<td>Digital clock with accessories for automatic switching ON/OFF of street lights</td>
<td></td>
<td></td>
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<tr>
<td>xxxiv</td>
<td>Any Other item if,</td>
<td>LS</td>
<td>As required</td>
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**Sub total (C 2.2)**

**Sub total C.2 = C.2.1+C.2.2**

C.3 Training : -Rs.-----------------------------
# TABLE OF TOTAL PRICE

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<thead>
<tr>
<th></th>
<th>Sub head/item description</th>
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<tbody>
<tr>
<td>1</td>
<td>Sub-total of ‘A’</td>
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</tr>
<tr>
<td>2</td>
<td>Sub-total of ‘B’</td>
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<tr>
<td>3</td>
<td>Sub-total of ‘C.1’</td>
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<td>4</td>
<td>Sub-total of ‘C.2’</td>
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<td>5</td>
<td>Sub-total of ‘C.3’</td>
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<td>6</td>
<td>Insurance</td>
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<td>7</td>
<td>Contingencies</td>
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<tr>
<td>8</td>
<td>Works Contract Tax</td>
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<td>9</td>
<td>Service Tax</td>
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<tr>
<td>10</td>
<td>Other Taxes</td>
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<tr>
<td>---</td>
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<tr>
<td></td>
<td><strong>GRAND TOTAL (Summation of item ‘1’ to ‘10’)</strong></td>
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## D. WEIGHT & VOLUME FOR CIVIL & STRUCTURAL WORKS

<table>
<thead>
<tr>
<th>Item no</th>
<th>Sub head/item description</th>
<th>Quantity</th>
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<tbody>
<tr>
<td><strong>D.1</strong></td>
<td><strong>Civil &amp; Structural works</strong> (Broad quantities within a limit of ± 10% of actuals on completion)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Earth work in cutting in all types of soil &amp; rock</td>
<td>Cu.m</td>
</tr>
<tr>
<td>2</td>
<td>Earth work in filling i) Controlled filling ii) Un controlled filling</td>
<td>Cu.m</td>
</tr>
<tr>
<td>3</td>
<td>P.C.C at all level and as per system requirement. I) In 1:2:4 ii) In 1:4:8</td>
<td>Cu.m</td>
</tr>
<tr>
<td>4</td>
<td>R.C.C (Excluding reinforcement) i) M-15 ii) M-20 iii) M-25 at all level and as per system requirement</td>
<td>Cu.m</td>
</tr>
<tr>
<td>5</td>
<td>Reinforcing steel in all RCC in the system</td>
<td>M.Te</td>
</tr>
<tr>
<td>6</td>
<td>Structural steel works at all level and as per scope of work and system requirement excluding equipment frame work, chutes and liners</td>
<td>M.Te</td>
</tr>
<tr>
<td>7</td>
<td>22/24 Gauge C.G.I. Sheeting at all level</td>
<td>sq.m</td>
</tr>
<tr>
<td>8</td>
<td>Masonry works</td>
<td>Cu.m</td>
</tr>
<tr>
<td>9</td>
<td>Any other item</td>
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<tr>
<td><strong>D.2</strong></td>
<td><strong>Development Works and Infrastructure</strong> (Broad quantities within a limit of ± 10% of actuals on completion)</td>
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<tr>
<td>1</td>
<td>Internal road of 3.5 m with</td>
<td>km</td>
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<tr>
<td>2</td>
<td>Different type of drains i) Type - A ii) Type - B iii) Type - C</td>
<td>km km m</td>
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<tr>
<td>3</td>
<td>10 ft height boundary wall</td>
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<tr>
<td>4</td>
<td>Levelling and dressing of vacant area within battery limit</td>
<td>sq.m</td>
</tr>
<tr>
<td>5</td>
<td>Service building/Office buildings in floor area</td>
<td>sq.m</td>
</tr>
<tr>
<td>6</td>
<td>Loading complex area</td>
<td>sq.m</td>
</tr>
<tr>
<td>7</td>
<td>Any other item</td>
<td></td>
</tr>
</tbody>
</table>
Instructions:

1. Bidders are required to quote the quantity, unit price, amount and taxes etc. in the respective column. Unit price should be in word as well as in figure.

2. Quantity should be as per scope defined in the tender document and should cover all the requirement of the system.

3. ± 10% clause
   Based on civil and structural quantities of works as given by the bidder in sub head A, B & C of this proforma, the shortfall in total quantity of all civil and structural works shall be allowed up to 10% only to every individual items. For shortfall of quantities exceeding 10%, there shall be proportional reduction in the price of the individual items resulting the reduction in the award value by the same amount. Contractor should absorb upward variation in quantity of individual items for civil and structural works unless specifically stated otherwise in the document.

4. The above items of work are to be executed strictly as per IS provisions.