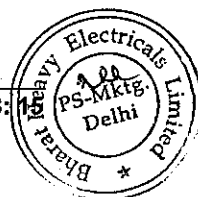
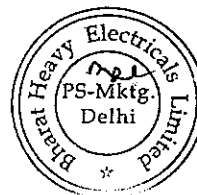


- **"QA Programme"** shall mean the comprehensive quality control and quality assurance programme to be followed by the Contractor in executing the Supplies, Construction/ Erection of the Works.
- **"Risk Transfer Date"** shall, subject to the obligation of the Contractor including, without limitation, in relation to the Performance Guarantee Test (and consequences of failure thereof including rejection) and Warranty, mean the date on which the Owner assumes the care and custody of the Equipment/Plant or the Plant enters in to Commercial Operation whichever is earlier.
- **"Schedule"** shall mean collectively all the schedules including Project Schedule, Milestone Schedule and other schedules pertaining to the work and the Plant as detailed in the Contract.
- **"Specifications"** or **"EPC Specification"** or **"Technical Specification"** shall mean collectively, the description of the scope, the Owner's requirements, design criteria, technical requirements, Final Proposal, drawings, programme of work Project Schedule, all Appendices to the contract, Appendices to these General Conditions of contract, Performance Guarantees, all terms and stipulations of the contract, and such amendments and revisions, as may be made in the Tender Documents or to the contract and all written agreements made after the execution of the contract by the Parties, or which may pertain to the method and manner of performing the work under the contract as agreed.
- **"Sub-contractor"** shall mean any Person (other than the Contractor or the Owner) to whom any part of the Works has been sub-contracted by the Contractor in accordance with the Contract and with prior approval of the Owner, or with whom the Contractor has entered into any contract for the supply of any Equipment in connection with the Works and with prior approval of the Owner, and shall include its legal successors in title or permitted assigns, and unless otherwise stated, all the Sub-contractors and suppliers to such Person and the term Sub-Contract shall be construed accordingly.
- **"Supplies"** shall mean the supply of the Equipment and the Mandatory Spares by the Contractor in connection with the performance of its obligations under the Contract, including all incidental activities thereto,
- **"Site"** shall mean the land and other places including existing roads and paths put at the disposal of the Contractor by the Owner in connection with the execution of the Contract.



- **"Synchronisation"** shall mean electrical connection of the Plant to the Grid by means of the Interconnection Facility for the first time where the Plant and the Grid are matched in voltage, phase and frequency, after satisfactory Commissioning.
- **"Take Over" or "Taking Over"** shall mean taking-over of the whole Plant by the Owner for the purpose envisaged under the Contract after Commercial Operation Date and after successful completion of Performance Guarantee Tests complete within three months from the Commercial Operation of the Plant and successful completion of Tests Before Take Over, as well as liquidation and completion of pending items specified in Punch List in pursuant of the Contract.
- **"Temporary Works"** shall mean all temporary works of every kind (other than Contractor's Equipment) required for the execution and completion of the Works and the remedying of any defects.
- **"Tender Documents"** shall mean the documents for Invitation to Bid together with all amendments thereto and clarifications, if any, issued by the Owner or the Consultant from time to time in respect thereof.
- **"Tests before Commercial Operation"** shall mean in relation to the Plant, all tests prescribed in the Specification and any other tests agreed between the Owner and Contractor to be undertaken by the Contractor.
- **"Tests before Take Over"** shall mean the tests prescribed in the 'Specification', and any other such tests as may be agreed between the Owner and Contractor or instructed as a Change Order, which has to be carried out by the Contractor before the Plant is Taken Over.
- **"Tonne"** shall mean 1,000 Kilogram weight.
- **"Transmission Facilities"** shall mean all of the facilities to be located off the Site and to be constructed by or for the GETCO to connect the Interconnection Facilities to the Grid.
- **"Reliability Run Test" or "Trial Run"** of the Plant shall mean the -Period of 14 days of continuous operation after Synchronization, or extended period thereof if any as more particularly defined at Vol-II A/S-10/CL2.02.02 .
- **"Tests on Completion"** shall mean such tests as are prescribed in the Specifications and/or other tests as mutually agreed upon by the Owner and the Contractor to be carried out by the Contractor to prove satisfactory performance of the Works.
- **"Ton"**, shall mean 1,000 Kilogram weight, "Gallon" shall mean Imperial gallon, unless otherwise mentioned specifically.
- **"Unexpected Archaeological Condition"** shall mean uncovering or revealing of an unknown historical or archaeological site at or contiguous to the Site during performance of the Contract that was not

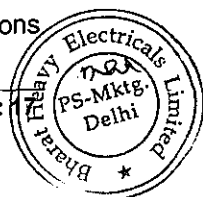
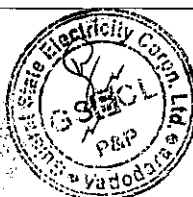


shown or indicated in the Subsurface Investigation and which Contractor could not have reasonably been expected to be aware of.

- **"Unpriced Technical Bid"** shall mean the unpriced technical bid submitted by the Successful Bidder as part of its Final Proposal
- **"Variation"** shall mean alterations, amendments, omissions, additions, or variations of the Equipment or the Supplies as agreed.
- **"Warranty"** shall mean all guarantees and warranties provided or agreed to be provided under the Contract for and in respect of the equipment, work, components, materials, Supplies and parts and works forming part of or incorporated in the Plant or relating thereto supplied or provided by the Contractor and shall include any guarantee or warranty provided or furnished by a sub-Contractor under a sub-contract.
- **Warranty Engineer** shall mean, the engineer deputed by the Contractor and staying at site, to be responsible for looking after / supervising Operation and Maintenance practices during warranty period.
- **"Week"** shall mean a continuous period of seven (7) Days.
- **"Wilful Misconduct"** shall mean that the Contractor has intentionally concealed the defect in full knowledge of the serious consequences that may flow from its existence and the defect is one, which the Owner could not have discovered on careful examination of the Plant at the time of commencement of Commercial Operation or during the Warranty Period.
- **"Work"** or **"Works"** shall mean the works and services involving engineering, procurement, Supplies, construction, installation, erection, Commissioning of the Plant and shall include all Permanent Works comprised in or forming part of the Plant and the temporary works or either of them as appropriate, and any other works required to be performed by the Contractor under the Contract.
- **"Warranty Period"** shall have the meaning assigned to the term under Clause 21.2 of the GCC, during which the Contractor shall bear all cost covering repair and/or replacement of any defective part of the Plant/ Equipment supplied, works done and services rendered under the Contract.

2.2 Interpretation of Bid Document

- 1) General Conditions shall be read in conjunction with Instructions to Bidders, special Conditions, Technical Specifications, Drawings and other documents forming part of the Bid Document wherever permissible or the context so requires.
- 2) Notwithstanding the sub-division of the Bid Document into sections and volumes, every part of each shall be deemed to be supplementary to and complementary of each other.
- 3) All headings and marginal notes to the items of the General Conditions



or to the Specifications or to any other document forming part of the Bid Document are solely for the purpose of giving a concise indication of the general subject matter thereof and not a summary of the contents thereof and they shall never be deemed to be part thereof or be used in the interpretation or construction thereof.

- 4) Wherever it is mentioned in the Bid that the Contractor shall perform certain work or provide certain facilities it is understood that the Contractor shall do so at his cost and the price shall be deemed to have included the cost of such performances and provisions so mentioned.
- 5) The materials, designs and workmanship shall satisfy the applicable standards, specifications contained herein and codes referred to. Where the Bid Document stipulates requirements in addition to those contained in the standards and codes, those additional requirements shall also be satisfied.
- 6) For the purposes of the Contract including General Conditions of Contract, the expression "legally, safely and reliably placed in commercial operation" shall mean that the Facility, will operate in the manner intended as described in the contract, in accordance with all Applicable Laws and Applicable Permits, and without undue risk of damage or injury to the Plant or Persons.
- 7) Words incorporating the singular only shall also include the plural and vice -versa where the context requires.
- 8) "Writing" shall include any manuscript typed or hand-written or printed statement, including E- Mail and facsimile transmission under or over signature or seal as the case may be.

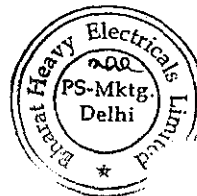
2.3 Priority of documents

For the purpose of interpretation of the Contract, especially in the event of any inconsistency, the following order of precedence shall apply:

Order of Precedence:

The order of precedence shall be the order in which the documents are listed below:

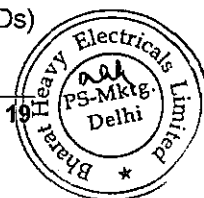
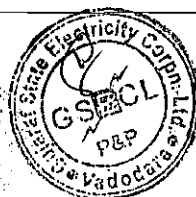
- i) The Contract Agreement
- ii) Letter of Award duly accepted by the Contractor together with its amendments, if any.
- iii) Pre Award Minutes of Meeting, Resolutions to Deviations / Clarifications
- iv) Pre-bid clarifications issued by the Owner and Amendments to Tender specifications
- v) General Conditions, ITB, Special conditions for erection and Construction
- vi) Technical Specifications
- vii) Contractor's Bid Proposal



3.0 SCOPE OF WORK

3.1 The scope of work, if not otherwise mentioned in the Contract, shall be on the basis of a single Contractor's responsibility, completely covering all the equipment specified under the accompanying Technical Specifications. The Works include the following: -

- a) Detailed design of all the equipment and sub-systems as per Specifications;
- b) Complete manufacture of all the Equipment including shop assembly and testing as per Specifications, supply of special tools and tackles and services necessary for satisfactory execution of the Contract;
- c) Providing Engineering Drawings, Data and operation manual, etc. for Owner's/Consultant's approval.
- d) Packing and transportation of the Goods from the Manufacturer's Works to the Site including freight charges, insurance coverage;
- e) Supply of Mandatory Spares;
- f) Receipt, unloading, storage, preservation and conservation of the Goods at the Site;
- g) Erection, Testing and Commissioning, trial run of all the equipment at the Site, Tests on Completion, putting into Commercial Operation;
- h)
 - i) Performance Guarantee Tests on successful completion of Reliability Run
 - ii) Reliability Test shall commence after completion of Commissioning of the Plant. Length of such operation shall be as specified in [VOL-IIA/S-10/CI 2.02.02 PAGE 3] of the Contract.
- i) Providing construction, erection, testing and commissioning supervision personnel to supervise the work, erection, testing and Commissioning of the Plant;
- j) All civil works including supply of all materials and temporary works etc. as needed;
- k) Structural work including supply of all materials, Consumables and temporary works etc. as needed;
- l) Architectural works as approved by the Owner;
- m) Providing three sets of as commissioned Drawings, three sets of as commissioned data/specification/parameter sheets duly signed by the relevant competent authority, and five sets of Compact disks (CDs) should be submitted prior to Take Over.



Provided that all Works shall be done as per the requirements of the Contract including, without limitation, the Drawings and Documents approved by the Owner and the Specifications.

Provided further that the Contractor shall, unless specifically excluded in the Contract, perform all such Work and/or supply all such items and materials not specifically mentioned in the Contract but are required for attaining Commercial Operation of the Plant as if such work and/or items and materials were expressly mentioned in the Contract and in a manner that ensures that the Plant is fit for the purpose intended.

3.2 STANDARD OF CARE

The Contractor shall execute and complete the Works in a safe, prudent and reliable manner in strict accordance with the Contract and with Good Engineering Practices.

4.0 CONTRACT PRICE

4.1 The Contract Price shall be for the entire scope of the Work with the breakdowns as specified in Schedule of Prices.

The Contract Price shall be lump-sum and firm, and valid for the entire period of the Contract.

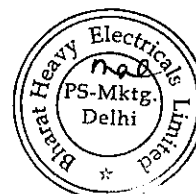
4.2 The price for the Goods of origin outside India shall be the CIF Price.

4.3 Taxes and Duties

4.3.1 For the Goods of Indian origin, all Taxes shall be deemed to be included in the Contract Price. However excise duty, sales tax, works contract tax, octroi, and similar taxes as payable on finished goods and included in the Contract Price shall be indicated separately considering exemptions which may ordinarily be available/applicable at the prevailing structured rate. Further, Service Tax on Service portion of the Contract will be indicated separately. The normal prevailing rates of aforesaid taxes and duties and exemptions/concessions to the same with concessional rates shall be indicated. In case of delay in delivery not attributable to the Owner, any increase in the rates of aforesaid taxes beyond the scheduled date of delivery shall be to the Contractor's account. The amount of aforesaid taxes paid shall be reimbursed to the Contractor by the Owner upon presentation of documentary evidence upto the limit indicated in the bid offer.

4.3.2 The Taxes and Duties mentioned in Clause 4.3.1 for direct dispatch able items to Site from bidder's Sub Contractors, Sub Vendors, JV Companies whose works are located within India shall be reimbursed by the Owner upon presentation of documentary evidence upto the limit indicated in the bid offer.

4.3.3 In the case where Equipment have been listed under the schedule of items of foreign origin (to be imported) and such list have been accepted by the Owner, the responsibility of obtaining an import license, taking procedures thereon and payment of Taxes will rest with the Contractor though technically Owner will remain as an Importer. The Contractor shall prepare all required documents for



the Owner to make application for such import license and extend all possible assistance to the Owner for expeditious clearance of the license as and when requested by the Owner. The Contractor shall also arrange for payment of Taxes against any consignment on behalf of the Owner and the amount paid towards Taxes will be reimbursed by the Owner to the Contractor in Indian Rupee on presentation of documentary evidence as per Contract. In the case of delay in delivery not attributable to the Owner, any increase in the Taxes, port handling and port clearing charges as well burden due to rise in foreign exchange rate shall be to the Contractor's account.

The Bidder is to furnish a detailed list of imported equipment and materials and quantities against each item along with his Bid.

4.3.4 In the case of raw materials, components, sub-assemblies and other equipment and materials imported by the Indian Contractor for value addition, construction materials and Consumables, if any, all such import duties and levies payable shall be deemed to have been included in the Contract Price and no separate claim on this behalf will be entertained by the Owner.

4.3.5 Additionally, the Contractor shall bear and shall be liable for the payment of its Personal Taxes.

4.3.6 The Contractor and all its expatriate personnel shall be responsible for the timely and prompt filing of all returns, documents, estimates, accounts, information and details complete and accurate in all respects as may be required under the applicable laws/regulations of India by the appropriate authorities in India. In case the Contractor or any of its expatriate personnel do not comply with the above requirements, which results in any penalty, interest or other liability, the same shall be borne by the Contractor.

4.3.7 GSECL will arrange C Forms as applicable on quarterly basis. Also TDS certificate will be issued on quarterly basis.

4.3.8 Taxes and duties in the proposal shall be the rates prevailing fifteen (15) days prior to the date of opening of Techno Commercial Bid.

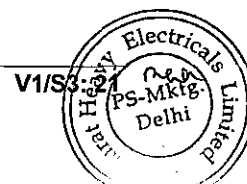
4.4 Price Adjustment for Quantity Variation in the Works and Change Order

4.4.1 Quantities of Equipment required by the Specification may be in certain cases, subject to variation pursuant to the Change Order in accordance with the procedure set out in this Clause 4.4.

4.4.2 Changes

(i) Owner shall have the right at any time by written notice to Contractor to make changes to the Work, whether such changes are modifications, alterations, deletions or additions. Contractor agrees to effect such changes in the Work as Owner may from time to time request subject to mutual agreement. The Change Order shall be limited within +/- 15% of Total Contract Price.

(ii) Any request by Owner for a change shall be delivered to Contractor in writing and shall be sufficiently definite and detailed to give Contractor an adequate basis on which to prepare a preliminary change order pursuant to Clause 4.4.3.



(iii) Upon receipt of Owner's request for a change, Contractor shall prepare a preliminary change order and deliver the same to Owner within ten (10) days time or any reasonable time mutually agreed following Contractor's receipt of such request.

(iv) Throughout the performance of the Works Contractor shall have a continuing obligation to suggest to Owner for Owner's consideration:

(a) All such changes as Contractor considers desirable; and

(b) Such other changes known to Contractor as may be necessary to incorporate significant new developments in technology which are applicable or appropriate to the Plant.

(c) Contractor shall submit any such suggestion in the form of a preliminary change order pursuant to Article 4.4.3.

4.4.3 Preliminary Change Orders

(i) Each preliminary change order submitted by Contractor to Owner pursuant to Clause 4.4.2 or any other express provision of the Contract shall be in writing and be accompanied by such information and data as will be reasonably required by Owner to evaluate properly the proposed execution of the work in question, the effect, if any, on the Work, scope of Work, an adjustment in one or more of the (i) Contract Price, (ii) Guaranteed Commercial Operation Date, (iii) Milestone Payment Schedule, (iv) any of the Performance Guarantees, or (v) any provision/scope of the Contract.

(ii) Owner shall reject or approve at its sole discretion each preliminary change order as expeditiously as proper consideration of the nature of the change may reasonably permit.

(iii) The cost of all work involved in preparing the information and data required to accompany the preliminary change order involved and for any additional analytical or investigative work requested by Owner in connection therewith is included in the Contract Price.

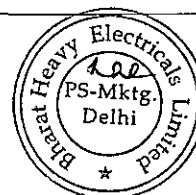
4.4.4 Change Orders

(i) Except as provided in Clause 4.4.5, Contractor shall not act upon any preliminary change order unless the Owner has executed a written Change Order.

(ii) Any adjustment of the Contract Price pursuant to the Change Order shall take into account, among other things, the elimination or avoidance of Work to be performed resulting from the changes in the Work and from assistance given by Owner.

4.4.5 Performance of Change Order pending agreement

If Owner and Contractor fail to agree on the effect of a Change Order and as a result a Change Order is not executed, Owner may nevertheless require Contractor to perform the Work as changed by delivering to Contractor a Change Order signed by Owner and Contractor shall complete all work specified in such Change Order and the dispute shall be resolved as provided in Clause 39:



The Owner shall pay to the Contractor in accordance with the Contract, such amount as has been ascertained by Owner as payable for such Change Order pending the resolution of the dispute. Contractor's performance of the Work as changed shall not prejudice either party's position regarding the effects of such change.

4.4.6 Variations in Contract Price

Except as otherwise provided in the Contract any increase or reduction of the Contract Price resulting from any Change Order shall be for the account of Owner, provided that no increase in the Contract Price shall be granted with respect to a change if:

- (1) The providing of the additional services is necessary in order for Contractor to satisfy its responsibility to make the Plant operable and capable of performing as contemplated under the Contract and to ensure that the Plant when completed and the Work is performed in accordance with the Contract;
- (2) The additional services are required because of delays attributable to Contractor, to late deliveries of Equipment or Contractor's Equipment or to labour shortages or relate to any rectification or remedy of defects or deficiencies required under the Contract;
- (3) The additional services are required because of a breach of any of the Guaranteed Commercial Operation Date and Performance Guarantees or Warranties under the Contract; or
- (4) The change relates to re-performance of any of the Work because of Contractor's failure to follow Owner's Specifications.

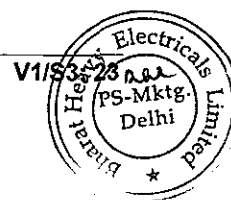
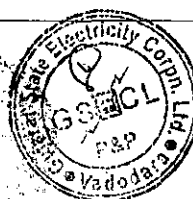
It is clarified that any adjustments in the Contract Price shall be made only in accordance with this Clause 4.4.

4.4.7 Not Considered Changes

Without prejudice to any other provision of the Contract, the following shall not be considered under any circumstances as changes in or within the Work, nor shall any of the following be taken into account when calculating the effect upon the Contract Price of changes in or within the Work nor shall any of the following of themselves be considered the basis for any adjustment of the Contract Price:

- (1) Any escalation in the cost of Equipment or labour;
- (2) Any increase in manpower hourly rates;
- (3) Currency fluctuations in respect of costs included within the Contract Price; and
- (4) Any change in the sourcing of Equipment.

4.4.8 The Work shall be subject to further detailing by the Parties from time to time and that, such detailing shall not be considered as a change in Work. In addition, a request by Owner that Contractor perform services or provide Equipment or Contractor's Equipment not specifically included within the Scope of Work shall not be considered a request for a change in the Work if it is required to make the Plant operable and capable of performing as specified in the Contract.



5.0 **TIME : THE ESSENCE OF CONTRACT**

The time and date of completion of the Work as stipulated in the Contract Document and the Guaranteed Commercial Operation Date shall be deemed to be the essence of the Contract. The Contractor shall so organize his resources and perform so as to complete the Work not later than the aforesaid date.

The Contractor shall submit a PERT network showing various key phases of the Work such as design, procurement, manufacturing, shipment, and field erection and construction activities within thirty (30) days after the date of receipt of Notice to Proceed. This network where applicable shall indicate the interface facilities to be provided by the Owner and the dates by which such facilities are needed by the Contractor and also the programme for phase wise release of Work Site for erection work as may be needed by Contractor.

The Contractor shall discuss the network so submitted with the Owner and the same shall be finalized pursuant to such discussions. The agreed network 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 Document.

The above PERT network shall be reviewed and periodic review reports shall be submitted by the Contractor to the Owner as directed by him.

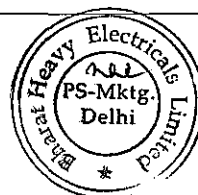
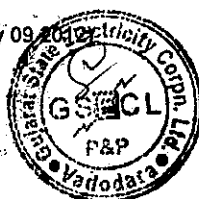
The Contractor shall make available to the Owner detailed manufacturing, delivery, erection, testing and commissioning programmes in line with the agreed PERT network in the form of PERT or Bar Chart as desired by the Owner within ninety (90) days from the date of receipt of Notice to Proceed. During performance of the Contract, such programmes shall be renewed, updated and submitted to the Owner as and when needed by him or periodically as specified by him. If in the opinion of the Owner/Engineer proper progress is not maintained, suitable changes shall be made in the Contractor's operation to ensure proper progress.

5.0A **TRANSFER OF TITLE AND RISK**

5.0A1 The legal title (but not risk which shall be transferred on the Risk Transfer Date) of the Equipment dispatched from any country outside India, shall be passed on to the Owner on the point of embarkation. However, the physical possession of such goods will remain in the hands of the Contractor for performance of the balance Scope of Work. The Contractor shall submit, in such form and within such time as required by the Owner, an indemnity bond indemnifying the Owner from any loss or damage to the equipment/material for the period between point and embarkation and the Taking Over the Plant by the Owner.

The transfer of title of goods shall take place when the goods in deliverable country/state are placed on board vessel for onward transmission to the Owner. The clean Bill of Lading issued by the Master of the Vessel shall be indicative of such deliverable country/state. Risk shall however continue to be that of the Consignor/Contractor upto the Taking Over of the Plant.

5.0A2 The Contractor shall remain responsible for, and shall bear the risk of loss or damage to, the Equipment in its possession and the Plant from the Commencement Date until the Risk Transfer Date. Provided that the transfer of risk shall be without prejudice to the obligation of the Contractor under the Contract.



6.0 PERFORMANCE BANK GUARANTEE FOR DUE PERFORMANCE OF THE WORK

6.1 The Contractor, upon receipt of Notice to Proceed from Owner shall furnish a Performance Bank Guarantee in the form specified as per Annexure-D as the performance security, for an amount equal to 17.5% of the total Contract Price under the Contract for diligent and due fulfillment by the Contractor of all obligations under the terms and conditions of the Contract. The initial Performance Bank Guarantee of 17.5% will be permitted to be reduced to 10% on completion of Reliability Run, completion of Performance Guarantee Test, and /payment of liquidated damages,(if applicable) whichever is later.

6.2 The Performance Bank Guarantee shall be liable to be invoked towards and claims and/or damages due to the Owner for failure of the Contractor to meet his obligations under the Contract. The Bank Guarantee shall be valid until it is released at the end of Warranty Period as stipulated in Clause 21 of this Section.

6.3 However, the amount of the Performance Bank Guarantee, after expiry of the Warranty Period, may be reduced in proportion to the Work released from Warranty obligations at the discretion of the Owner.

The Performance Bank Guarantee amount in case of divisible Contract shall be 17.5% of the total value of the Contract for the faithful performance of the Contract in accordance with the Contract Document. The guarantee amount shall be payable to the Owner in the currency of the consideration of the Contract without any condition whatsoever and their Guarantee shall be irrevocable.

6.4 In addition to the grounds specified above, The Performance Bank Guarantee is shall be liable to be invoked in the event:

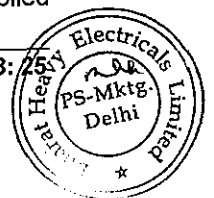
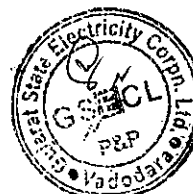
- a) The Owner has obtained an award in arbitration and the amount awarded has not been paid within thirty (30) days after the award, or
- b) The Contractor has gone into liquidation or has been declared bankrupt, or
- c) Any other reason which may adversely affect the contractual obligations of the Contractor.

Performance Guarantee is intended to secure the satisfactory performance by the Contractor of the entire Contract.

7.0 SUPPLY, ERECTION CONTRACT/DIVISIBLE CONTRACT

Notwithstanding anything stated elsewhere in the Bid Document, the Contract to be awarded is on the basis of Supply- Erection Contract (Divisible Contract) with single point responsibility. In the mode of contracting on the basis of Supply-Erection, the supply portion of the Contract will relate to the supply of the Plant and the erection portion will relate to port clearance, port handling, inland transportation, insurance, storage, unloading, erection, construction, testing, commissioning, Engineering, Project Management etc. as will be defined in the Contract Document.

In the case of a divisible contract, the title of ownership of Goods to be supplied



shall pass on to the Owner on dispatch Ex-works/F.O.B. However, until the Work is completed in all respects and the Plant is taken over by the Owner, the Goods shall remain within the custody of the Contractor. The above arrangement shall not in any way dilute the responsibility of the Contractor for the successful commissioning of the Plant and completion of other works as per Bid Specifications and both the contracts shall contain a cross default clause, namely, that a breach of one contract shall automatically be classified as a breach of the other contract, which will confer a right on the Owner to levy LD from other contractor and to terminate also the other contract as well at the risk and cost of the Contractor.

8.0 **TERMS OF PAYMENT**

8.1 The terms of payment for the price components of the Supplies of Equipment and Mandatory Spares, civil and architectural works, and erection are detailed in the Contract Agreement.

8.1.1 Initial Advance

The advance in accordance with the provisions of Clause 8.4, 8.5, 8.6, 8.7, and 8.8 of these GCC (each of such advance being referred to as "Advance Payment") will be paid on fulfillment of all of the following conditions by the Contractor:

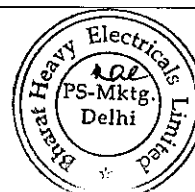
- i) Signing of Contract Agreement; (Agreement shall be signed within 45 days from the date of acceptance of LOA)
- ii) Submission of an unconditional Performance Security (Performance Bank Guarantee) as per clause -6.0 of the General Conditions;
- iii) Submission of an unconditional additional Performance Guarantee /by concerned entity, as prescribed by the Owner;
- iv) Submission of a preliminary Project network schedule indicating major milestones based on the Work schedule.
- v) Submission of Advance Payment Bank Guarantee as per clause-8.2 below.

Submission of detailed Project Network Schedule shall be made within 45 days from the date of signing of Contract.

8.2 **Documentation and Bank Guarantee for Advance Payment**

The Contractor shall furnish the following documentation as a condition for making request for Advance Payment.

- i) Invoice for amount of Advance Payment in original and five (5) copies.
- ii) Bank guarantee in the proforma attached with Volume-1, Section-2, Annexure-I-I for an amount equivalent to the aggregate amount of Advance Payment ("**Advance Payment Bank Guarantee**") with one (1) copy of original bank guarantee valid upto Take Over of Plant issued or counter guaranteed/confirmed by any Indian Nationalized Bank or its foreign branch. The charges for counter guarantee/confirmation, if any, shall be to Contractor's account.



- iii) Advance Payment Bank Guarantee for Advance Payment shall be denominated proportionately in currencies of contract or US Dollars.

8.3 Adjustment of Advance Payment

The Advance Payment made shall be adjusted against the progress payments, progressively at the same rate of advance i.e., if 10% advance paid, 10% of the invoice value of the progress payment will be adjusted against making progress payment. Upon each such recovery, the value of the Advance Payment Bank Guarantee shall be reduced progressively by the amount of advance so recovered by Owner from Contractor's progress payments. Apportioning the break-up of other payments shall be as further detailed below. All further payments under the Contract shall be made as stipulated in the Contract Agreement. Reduction of Advance Payment Bank Guarantee shall be permitted every six months i.e. January and July of each year based on records available with GSECL.

8.4 Design Engineering Charges

Design engineering charges component will be paid as per detailed break-up as set forth in the contract after issue of certification of completion of same by Contractor to Owner and acceptance thereof by Owner/Owner's representative in following installments:

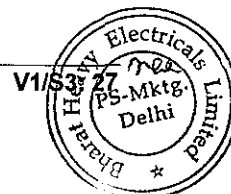
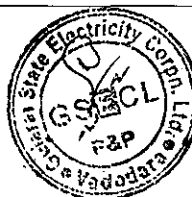
- i) 0 to 5% (max 5%) of Design Engineering Charges as Advance Payment on fulfillment of conditions in sub-clauses-8.1 and 8.2
- ii) 75% (cumulative not exceeding 80%) of Design Engineering Charges as progress payment on approval of drawings and document – payable in 36 monthly equated installments.
- iii) 7% (cumulative not exceeding 87%) of Design Engineering Charges on certification of successful completion of Reliability Run of Plant as per specification by Owner.
- iv) 6% (cumulative not exceeding 93%) of Design Engineering Charges on Final Plant Acceptance/Take- Over of Plant and also submission of as built drawings.
- v) 7% (cumulative not exceeding 100%) of Design Engineering Charges on Satisfactory completion of warranty period.

Contractor acknowledges that certification or its acceptance by the Owner's representative shall not, however, relieve or absolve in way or manner the Contractor from the performance of work and other obligations under the Contract including Performance Guarantee and Warranty obligations under the Contract.

8.5 Project Management Charges

Project Management charges component will be paid as per detailed break-up in following installments:

- i) 0-5% (max 5%) of Project Management charges as Advance Payment on fulfillment of conditions in sub-clauses-8.1 and 8.2



- ii) 75% (cumulative not exceeding 80%) of Project Management charges on equal monthly installments for the Contract Period.
- iii) 7% (cumulative not exceeding 87%) of Project Management Charges on certification of successful completion of Reliability Run of plant as per specification by Owner;
- iv) 6% (cumulative not exceeding 93%) of Project Management charges on Take Over of plant.
- v) 7% (cumulative not exceeding 100%) of Project Management Charges on Satisfactory completion of warranty period and also submission of as built drawings, O & M manuals etc.

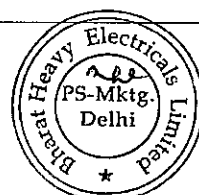
8.6

Supply Price

For Supplies of Equipments, the payments shall be linked with the despatch of materials and shall only be made after production of all despatch documents as specified in Letter of credit (L/C) conditions in case of supplies of non Indian origin and / or in the relevant contract conditions which will, inter-alia, include 3 original Bills of Lading in case of CIF supplies and the equipment Material Despatch Clearance Certificate issued by the Owner/Owner's representative after inspection if applicable.

- i) Supply price component will be paid as per break-up below:

Item No.	Time of Payment	% Component FOB/Ex-Works Price	Condition to be fulfilled
1.0	Advance Payment	0-5% (max 5%)	As per clauses-8.1 and 8.2 of this General Condition.
2.0	Advance Payment against placement of orders for major equipments.		
a)	Evidence of order placement of all major equipment/system	0-5% (cumulative not exceed 10%)	Evidence of order placement for all major Items to be ordered within first 6 months from zero date as per L1 schedule shall be considered-
b)	Despatch of Equipment/system from Manufacturer's Works	55% (cumulative not exceeding 65%)	Production of invoices and satisfactory evidence of shipment for major orders and submission of Material Despatch Clearance Certificate and Inspection Certificate as per quality assurance program.



Item No.	Time of Payment	% Component FOB/Ex-Works Price	Condition to be fulfilled
3.0	Receipt of equipment /system	15% (cumulative not exceeding 80%)	Verification and certification by the Owner / Owner's representative of the equipment / system received and stored at 'Site'
4.0	Successful Completion of Reliability Run	7% (cumulative not exceeding 87%)	Certification of successful completion of Reliability Run of plant as per contract by Owner.
5.0	Successful completion of Performance tests	6% (cumulative not exceeding 93%)	Take Over of Plant
6.0	Warranty Charges	2% 7% (cumulative not exceeding 100%)	Satisfactory completion of Warranty Period and Extended Defects Correction Period, as evidenced by issuance of Defects Liability Certificate, and also submission of O & M manuals, As built drawings etc.

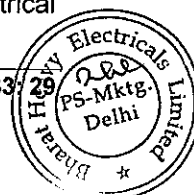
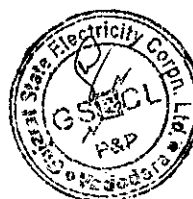
- ii) The Ocean Freight and Marine Insurance Charges and the in-land transportation and Marine insurance charges shall be paid to Contractor on pro-rata basis to the FOB price of component shipped on evidence of activities having been carried out. The aggregate of all such pro-rata payment shall not exceed the total amount identified in contract price provided, however, wherever equipment wise above mentioned charges have been identified in contract the payment of such charges shall be based on such charges identified in contract against evidence of activity having been carried out.

8.7

Erection, testing and Commissioning Price
(Excluding civil & architectural works)

In case of erection, progress payments shall only be made after the issue of Certificates by the Owner / Owner's representative, as detailed under:

- i) 0-5% (max 5%) of total erection, testing and commissioning price as Advance Payment and fulfillment of conditions in sub-clauses -8.1 and 8.2 above and on establishment of site office by the Contractor at site.
- ii) 75%(cumulative not exceeding 80%) of the erection, testing and commissioning price will be made as progressive payments against progressive erection on tonnage basis for mechanical and electrical



items and successful completion of quality check points. Separate basis for cabling and instrumentation, which will be finalized between Owner and Contractor prior to contract award. Progress payments shall only be made after the issue of Certificates by the Owner/Owner's representative, one for the quantum of work completed and the other by the Field Quality Surveillance representative for the successful completion of quality check points involved in the quantum of work billed.

- iii) 7% (cumulative not exceeding 87%) of the erection, testing and commissioning price on successful completion of Reliability Run of Plant as per contract.
- iv) 6% (cumulative not exceeding 93%) of the erection, testing and commissioning price on Take Over of plant.
- v) 7% (cumulative not exceeding 100%) of the erection, testing and commissioning price on satisfactory completion of warranty period.

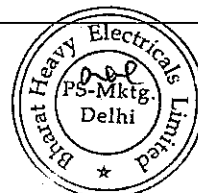
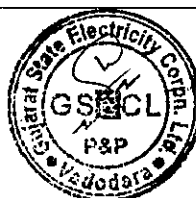
Further break-up of erection activities of the above identified equipment for progressive payments shall be as setforth in Milestone payment schedule.

8.8 Civil, Structural and Architectural Price

- i) 0-5% (max 5%) of total civil, structural & architectural price as Advance Payment and fulfillment of conditions in sub-clauses 8.1 and 8.2 above and on establishment of site office by the Contractor at site.
- ii) 75% (cumulative not exceeding 80%) progressive payment on certification by the Owner/Owner's representative on the basis of the work performed of total civil, structural and architectural price of the package as per the payment stages as setforth in Milestone Payment Schedule.
- iii) 7% (cumulative not exceeding 87%) of total civil, structural and architectural price component on successful completion of Reliability Run as per contract.
- iv) 6% (cumulative not exceeding 93%) of total civil, structural and architectural price component on Taking Over.
- v) 7% (cumulative not exceeding 100%) of the total civil, structural and architectural price component on satisfactory completion of warranty period.

8.9 Mandatory Spare Price

- i) The FOB Ex-works including packing and forwarding charges price component of Mandatory Spares shall be paid as indicated below:
 - a) 75% of price component for Mandatory Spares after submission of material despatch clearance and inspection certificate, despatch to Site and submission of requisite shipping documents. An indicative list of the shipping documents is given under Clause 9.3 of these GCC.



- b) 25% of price component for Mandatory Spares on receipt and storage at Site and physical verification by the Owner/Owner's Representative.
- ii) The ocean freight and marine insurance charges and the inland transportation and insurance charges shall be paid to the Contractor pro-rata to the value of Mandatory Spares received at Site on production of invoices by the Contractor.
- iii) Tools and tackles Prices: This shall form part of Supply Price and shall be claimed under supply payment.

Quantity variation in spares: The Purchaser may vary the quantity of mandatory spares to be ordered provided the ordered quantity results in a "whole number" or a "complete set". Order for spares with quantity expressed as a fraction will not be made. Variation in quantities, indicated in percentage or LOT will not be made. However, complete deletion of any item can be made.

8.10 **Not Used**

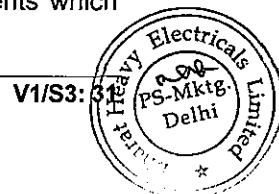
8.11 **Schedule of Payments**

Based on the terms of payment in clauses mentioned above and work schedule payment of Contract Price component linked with achievement of Milestones shall be paid in accordance with Milestone Payment Schedule. The Milestone payment schedule specifies the installments of Contract Price, and the Milestones to be achieved and the payment thereunder shall be subject to the following:

- i) The installments quoted in the Milestone payment Schedule may be modified by Owner / Owner's representative if progress is not as scheduled.
- ii) Payment shall be made on the date which is the later of (i) accomplishment of a milestone and (ii) the date fixed for accomplishment of such a milestone as set out in the Milestone Payment Schedule.
- iii) Submission of documentation/data to Owner/Owner's representative for approval.
- iv) Submission of monthly progress reports and updated Network Schedule

8.12 **Application for Interim Payment Certificates and Claim for Payments**

- 8.12.1 The Contractor shall submit a statement (the **Interim Payment Certificate**"), in six copies to the Owner/Owner's representative after the end of each month before the tenth day of the next month, in a form approved by the Owner/ Owner's representative, showing the amounts to which the Contractor considers himself to be entitled, together with supporting documents which



shall include the detailed report on the progress during the month. In order to be eligible for payment, the Interim Payment Certificate shall include the following items, as applicable, which shall be expressed in the currencies in which the contract price is payable, in the sequence listed:

- i) The estimated contract value of the Design and construction documents produced and the Works executed up to the end of the month (including variations but excluding items described in subparagraphs (iv) to (vii) below);
- ii) Certification from Owner/Owner's representative that the applicable Work has been performed and that the quality of Work described in the Interim Payment Certificate is in line with contract;
- iii) If there is any pending or threatened dispute, regarding Work covered by such request or payment as a result of which Contractor intends to withhold payment from such sub-Contractor, a report detailing such dispute and circumstances thereof;
- iv) Any amounts to be added and deducted for which Change Order has been issued;
- v) Any amounts to be added and deducted for the Advance Payments and repayments in accordance with clause 8.3 above;
- vi) Any other additions or deductions which may have become due in accordance with the Contract including, without limitation, deduction on account of liquidated damages.
- vii) The deduction of the amounts certified in all previous Interim Payment Certificates.
- viii) Any other information that the Owner/Owner's representative may reasonable request.

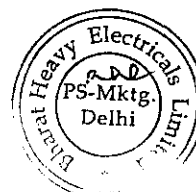
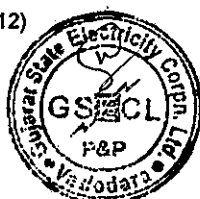
8.12.2 Contractor shall raise its consolidated invoices/bills only once a month.

8.13 Mode of Payment

8.13.1 For supply of Equipment and Mandatory Spares:

The mode of payment by Owner to the Contractor shall be mutually agreed before finalization of Contract. The same may be by way of establishing an irrevocable Letter of Credit (L/C) in favour of the Contractor through a bank in case of supplies of Non-Indian origin directly to Owner and through a nationalized bank to be nominated by the Contractor in case of Indian Supplies only for payments due on despatch of equipment or by way of direct disbursement of loans. The payment will be made through usance L/C as per credit period of payment specified in the specification. The L/C format will be mutually decided during finalization of Contract.

The value of L/C will be as per payment schedule for each quarter and valid for a quarter. It will be the responsibility of the Contractor to utilize the L/C to the fullest extent. In case L/C has been established by the Owner and not utilized by the Contractor, all reinstatement charges for the L/C for further period necessitated due to non-utilization of L/C will be to the account of the



Contractor.

All L/C charges shall be to Owner's account except L/C charges for confirmation by Contractor's bank which will be borne by the Contractor. For non-Indian supplies, Contractor shall be responsible for all permits, licenses and the like from respective authorities necessary for export of equipment from the respective countries to the Owner.

8.13.2 For Other Payments

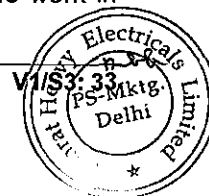
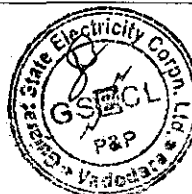
The payment of advance(s), price adjustment, any other supply payment, ocean freight, marine insurance, Taxes (wherever admissible), inland transportation (including port handling), insurance, civil and architectural works and for the erection portion of the Works shall be made direct to the Contractor by the Owner.

8.13.3 Unless otherwise agreed by the parties, payments by Owner to Contractor, shall be made in currencies as per Schedule of Prices by cheque to an account or accounts designated by Contractor and maintained by Contractor or by such other person or entity at a bank or banker in Vadodara, Gujarat, India in writing. Extra Work shall be paid in accordance with the applicable Change Order as part of the work under the Contract. Once all acts necessary to initiate the relevant wire transfer have been completed within the time specified for such payments, any delays within the international or domestic banking system in the transfer of such payments to Contractor's account or accounts as aforesaid shall not give rise to a claim that Owner has breached its payment obligations hereunder.

Payment will be made in the respective currencies quoted by the bidder for onshore supply for import content of raw material of onshore supply. Bidder shall have to provide the drawdown schedule in respective currencies & to include in price bid accordingly.

8.13.4 The Owner shall pay the amount certified in each Interim Payment Certificate within 30 days from the date on which the Owner/Owner's representative received the Contractor's statement and supporting documents and the Owner shall pay the amount certified in the Final Payment certificate within 120 days from the date of issue of the Take Over certificate.

8.13.5 Pursuant to this clause-8.0, if the commercial banks are closed due to a public holiday, period as above shall be extended to the first business day after the end of the period concerned. In addition, unless the parties otherwise agree, Owner shall not be obligated to pay, in respect of any request for payment, any amount in excess of 100% of the cumulative amount anticipated to be paid for work completed to such date, as set forth in the projected payment schedule as per Schedule of Prices. If any request for payment does not comply in all material respects with the Contract, Owner shall inform Contractor about the same within 15 days following the receipt of such request for payment, and Contractor shall re-submit such request for payment. If less than the full amount is paid, Owner shall state in writing the reasons for paying such lesser sum. Any dispute regarding Owner's payment of a lesser sum than that set forth in a request for payment must be raised by Contractor within 30 days of receipt of such payment, or Contractor's right to dispute such payment is waived. During the pendency of any such Dispute and the resolution thereof, Contractor shall continue to perform the work in



accordance with the provisions set forth herein.

8.14 Payments Withheld

8.14.1 Owner shall have the right to withhold from any payment due to Contractor, including the final payment, such amounts as Owner reasonably deems necessary or appropriate to protect it because of any one or more of the following reasons:

- i) Defects in any work, which might affect Owner's ability to operate Unit or Plant as contemplated herein, whether or not payment has been made therefor;
- ii) The filing of a any vendor/tradesman's lien or similar encumbrance in respect of the work or the plant (or any portion thereof);
- iii) A dispute as to the accuracy or completeness of any request for payment received by Owner pursuant to this clause-8.0 within 90 days of receipt thereof or payment made thereunder;
- iv) Contractor's failure to deliver any Performance Securities and additional performance to Owner as in the Contract;
- v) Any requirement in accordance with Applicable Laws to withhold any Taxes payable by Contractor in respect of the work or any part thereof; and
- vi) Contractor's failure to make payments to sub-Contractors or workers for work, including amounts withheld by Contractor because of disputes between Contractor and such Persons.

8.14.2 In addition to the provisions of this clause-8.0 which relates to the recovery by the Owner of any amounts that the Owner may have paid, for which the Contractor is liable under the contract, the Owner shall also be entitled to recover all the dues in terms of the contract including liquidated damages for delay, liquidated damages for the shortfall in the guaranteed performance parameters, etc by way of deductions from the payments due to the Contractor or that may become due to the Contractor in future or from any securities/guarantees under the contract and/or otherwise.

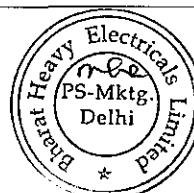
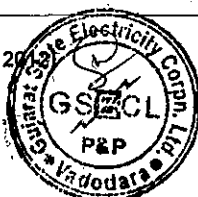
8.14.3 Notwithstanding any dispute that Contractor may have, and regardless of the basis thereof or grounds there for, Contractor agrees that it will, for so long as the Contract has not been terminated diligently prosecute the Work up to Take over of Plant, all in accordance with the terms of the Contract.

9.0 SHIPPING PARTICULARS

9.1 The Contractor shall be responsible for the correct appraisal of freight rates, weights and volumes of structural's or machinery as the case may be. The Owner shall not be liable to pay any warehouse or wharf age charges due to the necessity of storing Goods awaiting shipment.

9.2 All consignments shall be addressed to and the bill of lading and other shipping documents shall be made in the name of the Consignee.

9.3 After shipment is effected, the following documents shall be forwarded to the



Consignee by registered air mail/courier services.

- | | | |
|------|--|---|
| i) | The original bill of lading in duplicate and four (4) non-negotiable copies of the same. | |
| ii) | F.O.B. invoices | Six (6) copies including one (1) original |
| iii) | Freight invoice & freight details | Six (6) copies including one (1) original |
| iv) | Insurance premium receipts or certificates | - Ditto - |
| v) | Packing list | - Ditto - |
| vi) | Certificate of origin | Six (6) copies including one (1) original |

10.0 DELIVERY TERMS

10.1 When the Goods are ready for shipment, the Owner should be notified by the Contractor through fax or email. Notification of dispatch and delivery in regard to each and every consignment shall be made to the Owner immediately after dispatch and delivery in case of delivery at either the Site or at the port of entry as applicable at least forty-eight (48) hours ahead of actual delivery. The Contractor shall further supply to the Consignee an invoice and packing list of all Goods dispatched or delivered by him and other shipping particulars. All packages, containers, bundles and loose materials forming part of each and every consignment shall be described fully in the packing list, and full details of the contents of packages and quantity of goods shall be submitted to the Owner.

10.2 For the Goods imported by the Contractor, the Contractor shall deliver the Goods at CIF price. The Contractor shall also make all arrangements to deliver the Goods to the location specified in Technical Specifications.

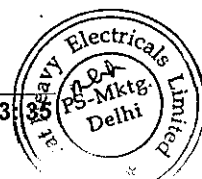
11.0 LIQUIDATED DAMAGES

11.1 Delay

Scheduled dates for Commissioning will be as specified in Schedule [insert] of the Contract. If the Contractor fails to achieve Commissioning within the time fixed thereof, he shall be liable to pay liquidated damages for the delay at the rate of half percent (½%) of the total Contract Price per week of delay. The total amount of liquidated damage on account of delay shall not exceed 10% of the Total Contract Price considering all types of Contracts including supply and erection.

11.2 Failure to meet Performance Guarantees

The liquidated damage for non fulfillment of Performance Guarantees will be as indicated below.



Sl. No.	Item	Value
1.	For increase in each Kcal/KWh of weighted average plant overall heat rate.	Rs. 7.5 Crores
2.	For every KW shortfall in gross power output at generator terminal	Rs. 100,000
3.	For increase in Auxiliary Power Consumption per KW	Rs. 200,000
4.	~~For every m³/hr increase in DM water consumption~~	Rs. 1 Crore

The total amount of liquidated damage for non fulfillment of Performance Guarantee shall be maximum 10% of the Contract Price considering all types of Contracts including supply and erection.

- 11.3 The total amount of liquidated damages on account of delay in Commissioning and non-fulfillment of Performance Guarantees shall not in any case exceed fifteen percent (15%) of the total Contract Price. The Owner shall deduct the amount of such liquidated damage from any money due or which may become due to the Contractor under the Contract, and/or recover such liquidated damage from the Performance Guarantee of the Contractor. To be entitled to impose the liquidated damage, the Owner will not be required to prove that he has incurred such amount as actual damages.

Liquidated damages to be paid in currency of the Contract Price on Pro-rata basis.

- 11.4 Rejection

If the total aggregate liquidated damages for short fall in Performance Guarantees of all parameters (shortfall in HR, power output, DM water consumption, Auxiliary Power Consumption) will be higher than 10% of the Contract Price then the Owner may at its option, either,

(a) Reject the Equipment/plant and recover the payments already made

Or

(b) Terminate the Contract pursuant to GCC 24.0 and recover the payments already made;

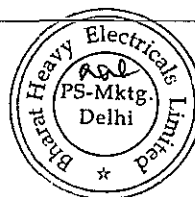
Or

© Accept the equipment after levy of liquidated damages in accordance with the provisions specified in GCC 11.0 of Contract Agreement.

- 12.0 **SHOP ASSEMBLY AND INSPECTION**

- 12.1 Shop Assembly

Shop Assembly to the largest extent feasible shall be performed by the Contractor to assure proper fitting of the various parts, and for checking the correctness of clearances and dimensions. Parts thus assembled shall be match-marked for reassembly at the Site, prior to dismantling for shipment. A detailed description of the intended shop assemblies shall be submitted along with a quality assurance plan.



12.2 Inspection before Shipment

No Goods shall be shipped before all tests and inspections have been carried out according to the Approved quality assurance plan unless otherwise instructed by the Owner.

The acceptance of any Goods prior to shipment shall in no way relieve the Contractor of any of his responsibilities for meeting all the requirements of the Specification and shall not prevent subsequent rejection if such Goods are found to be defective.

In case inspection of Equipment/Goods needs visiting foreign countries, cost of 10 man visits shall be considered in the contract. All expenditure including that for travel shall be borne by bidder.

13.0 **CONTRACTOR'S DRAWINGS AND DATA**

13.1 a) The Contractor shall be responsible for developing detailed Drawings to adopt equipment and materials to be supplied to the requirements indicated in the Specification and shall submit a list of such Drawings and a programme for submission of these Drawings and documents within ninety (90) days from the date of receipt of the Notice to Proceed.

b) The Contractor shall also provide the Owner with the following Drawings and documents in the number of copies mentioned in Technical Specifications as per agreed schedule.

i) Technical particulars conforming to the Specifications.

ii) Outline drawings of major equipment together with weights and sufficient overall dimensions.

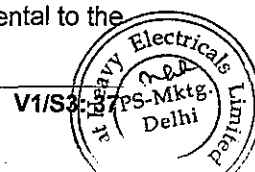
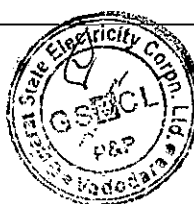
iii) Other drawings and documents as indicated in the Technical Specifications.

c) The Contractor shall, prior to submitting the Drawings and documents, submit to the Owner two copies of the Codes and Standards other than Indian Standards and Codes which shall govern the Works.

13.2 Copyright in the Owner's requirements and other documents issued by the Owner or the Owner's Representative to the Contractor shall (as between the parties) remain the property of the Owner.

The copyright in all drawings, documents and other materials containing data and information furnished to the Owner by the Contractor herein shall remain vested in the Contractor or, if they are furnished to the Owner directly or through the Contractor by any third party, including suppliers of materials, the copyright in such materials shall remain vested in such third party. The Owner shall however be free to reproduce all drawings, documents and other material furnished to the Owner for the purpose of the Contract including, if required, for operation and maintenance of the Facility

13.3 The Contractor shall indemnify the Owner in case of breach of this clause by the Contractor. If these documents are received by a third party from the Contractor and the third party makes use of these documents detrimental to the



Owner or use these documents for their personal gain, the Contractor shall compensate the Owner for the loss suffered as well as for the value of gain derived by third party.

14.0 MISTAKES IN DRAWINGS

The Contractor shall be responsible for and shall pay for any alterations of the Work due to any discrepancies, errors or omissions in the Drawings or other particulars supplied by him whether such Drawings or particulars have been Approved by the Engineer or not.

15.0 MATERIALS AND WORKMANSHIP FOR MANUFACTURER

All Goods to be supplied and all Works to be done by the Contractor under the Contract shall be manufactured and executed in the manner stipulated in the Specifications.

The Contractor shall use the best available materials for the Works. These materials shall be of recent manufacture, free from defects and imperfections and unused.

The highest standards of safety shall be adhered to during execution of the Works.

16.0 COMPLETENESS OF EQUIPMENT

The equipment supplied shall be complete in all respects. The Contractor shall not be eligible for any extra payment in respect of such mountings, fittings, fixtures and accessories if required for the safe and reliable operation of the equipment.

Parts of all similar equipment supplied shall be interchangeable with one another.

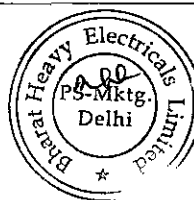
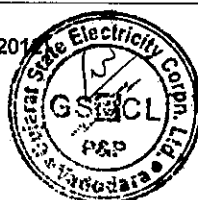
17.0 CERTIFICATE OF THE OWNER

Every application to the Owner for a certificate must be accompanied by a detailed invoice (in quadruplicate) setting forth in order of the schedule of quantities and prices as per Approved billing breakdowns of the Works executed and/or Goods ready for dispatch up to the date of claim. The certificate relating to such Goods and Work as in the reasonable opinion of the Engineer in accordance with the Specifications shall be issued within thirty (30) days of receipt of the application.

The Owner may, with any certificate, make any corrections or modifications to any previous certificates issued by him. The payments to be made against invoices under certification will be regulated and adjusted accordingly.

18.0 OWNER'S DECISION

In respect of all matters which are left to the decision of the Owner, including the granting or withholding of certificates; the Owner shall, if required to do so by the Contractor, give in writing a decision thereon and his reasons for taking such decision. If in the opinion of the Contractor, a decision made by the Owner



is not in acceptance with the meaning and intent of the Contract, the Contractor may file with the Owner within fifteen (15) days after receipt of the decision, a written objection to the decision. Failure to file such an objection within the allotted time will be considered to be acceptance of the Owner's decision and the decision shall become final and binding.

The Owner's decision and the filing of the written objection of the Contractor thereto shall be a condition precedent to the right to request for arbitration. It is the intent of the Contract Agreement that there shall be no delay in the execution of the Work in such cases and the decision of the Owner as given shall be promptly observed.

19.0 **CERTIFICATE NOT TO AFFECT THE RIGHT OF THE OWNER OR THE CONTRACTOR**

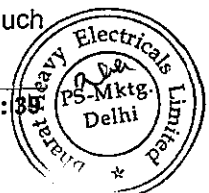
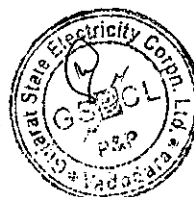
No certificate of the Engineer on account, nor any sum paid on account by the Owner, nor any extension of time for the execution of the Work by the Contractor under the powers granted by item "Certificate of the Owner" shall affect or prejudice the rights of the Owner against the Contractor, or relieve the Contractor of his obligations for the due performance of the Contract or be interpreted as Approval of the Work done or of the Goods supplied. No certificate shall create the liability for the Owner to pay for alterations, amendments, variations or additional work not ordered in writing by the Owner, or discharge the liability of the Contractor for payment of damages, whether due, ascertained or certified or not or of any sum against the payment of which he is bound to indemnify the Owner, nor shall any such certificate nor the acceptance by him or any sum paid on account or otherwise, affect or prejudice the rights of the Owner against the Contractor.

20.0 **OWNER ACCEPTANCE AND TAKE OVER CERTIFICATE**

In order to achieve Owner acceptance, Contractor must certify to the satisfaction of Owner/Owner's representative that:

- i) Reliability Run Test and Performance Guarantee Test have been completed to the satisfaction of Owner.
- ii) All punch list and pending issues have been completed in accordance with the contract;
- iii) All the Contractor's and sub-Contractor's personnel, supplies, unused materials, waste, rubbish and temporary facilities located at or near such plant have been removed from such location,
- iv) All other provisions of and all items required by the Contract have been performed or delivered, as the case may be, in accordance with the Contract and in a manner satisfactory to Owner.
- v) Contractor has delivered to Owner a Project Completion certificate certifying satisfactorily completion of each of the conditions set forth in sub-clauses -20(i) to 20(iv) above.

Upon certification by Contractor of satisfactory completion of sub-clauses -20 (i) through 20(iv), Owner shall issue a Take over Certificate certifying such



matters within 60 (Sixty) days

21.0 **WARRANTY**

21.1 The Contractor hereby provides following Warranty in respect of the Equipment to be furnished by the Contractor:

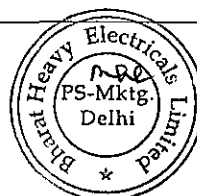
- a) All Equipment shall be new and in accordance with the Contract and shall be fit for the intended purposes,
- b) All Equipment shall be free from any defect due to faulty design, materials and/or workmanship.
- c) The Equipment shall perform satisfactorily and the performance and efficiencies of the specified Equipment shall not be less than the respective guaranteed values.
- d) The efficiencies, temperature rise and other performance data of all other Equipment shall be as per the Contract.
- e) All other Works including civil, structural and architectural works shall be in accordance with the Contract and free from any defect and omission.
- f) The Work will be designed so that the Plant is capable of being operated in a safe, reliable, economic and efficient manner, in accordance with the requirements of the Contract.

The Contractor undertakes to reaffirm the above Warranty, if so required by the Owner, in such forms as prescribed by the Owner and shall be signed by the Contractor and, if so required by the Owner, by Sub-contractor(s) of the Contractor.

If the Contractor finds, after his Tender is accepted, that a variation in work, construction technique or the quality of materials is necessary to fulfill the Warranty called for, such variations may be made with the approval of the Owner, provided the request for changes is made during execution of the contract Agreement and the changes are to be made without any increase in the price.

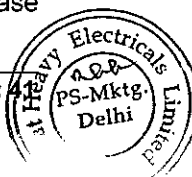
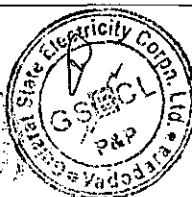
21.2 The Warranty shall be valid for a period of twelve (12) calendar months commencing from the date of Taking Over of the fully completed Plant at the discretion of the Owner. This period of the Warranty shall be referred to as the "**Warranty Period**".

21.3 During the Warranty Period, the Contractor's liability shall be limited to the replacement of any defective parts that may develop in Plant, of his own manufacture or those of his associate(s) and Sub-contractor(s) under the conditions provided for by the Contract under proper use and arising from faulty design, materials or workmanship. All such replacements of defective parts mentioned above shall be made free of cost at Site by the Contractor and the return of the defective parts to the Contractor's works shall be the Contractor's responsibility and shall be made at his expense. In the case of these defective parts which are not repairable at Site but are essential, in the Owner's opinion, for the commercial operation of the Plant or the Equipment, the Contractor shall replace at the Site, free of cost of the Owner the said defective parts before the



defective parts are removed to his Works in such a manner which will minimize interruption in the operation of the Plant and/or the Equipment. Provided always that such defective parts as are not repairable at Site, and are not essential in the meantime in the commercial use of the Plant, may be taken by the Contractor to the Contractor's works for repairs unless otherwise arranged. The decision to replace/repair the defective items shall be discussed and mutually agreed at appropriate stage.

- 21.4 The cost of any special or, general overhaul rendered necessary during Warranty Period due to defects in the Plant or defective Work shall be borne by the Contractor. The Owner will, however, render such assistance in this matter as will expedite the same.
- 21.5 If for rectification or replacement of any part of equipment or work due to defective materials, manufacture or design or workmanship, the services of the Contractor's personnel are requisitioned within the Warranty Period, these services shall be made available free of any cost to the Owner.
- 21.6 If it becomes necessary for the Contractor to replace or renew any defective portions of the Plant under this Clause, the provisions of this Clause will apply to the portions of the Plant so replaced or renewed until the expiration of **Extended Defects Correction Period**. Further, the Contractor shall ensure that the Performance Bank Guarantee shall remain outstanding or a replacement on-demand bank guarantee is delivered to the Owner in an amount equal to one hundred percent (100%) of the estimated value of each such item until the Extended Defects Correction Period applicable thereto has expired.
- 21.7 If any defect be not remedied within a reasonable time, the Owner may proceed to do the work at the Contractor's risk and expenses but without prejudice to any other rights which the Owner may have against the Contractor in respect of such defects.
- 21.8 If the replacements or renewals are of such character as may affect the efficiency of the Plant, the Owner shall have the right to give to the Contractor within one (1) month of such replacement or renewal, notice in writing that "tests on completion" be made, in which case such tests shall be carried out as provided in Clause on Tests on completion and Trial Run at the Site" in the Technical Specifications. Should such tests show that the Plant sustains the guarantee given in the Contract; the cost of the test shall be borne by the Owner. Should the guarantee be not sustained, the cost of the test shall be borne by the Contractor. Further, all necessary works will be carried out by the Contractor to achieve guarantee given in the contracts and perform tests to prove the same at his own cost.
- 21.9 Until the final certificate has been issued, the Contractor shall have the right of entry at his own risk and expenses by himself or his duly authorised representatives whose names shall previously have been communicated in writing to the Owner at all reasonable working hours of the Plant and taking notes there from and, if he desires, at his own expenses making any tests, subject to the approval of the Owner that will not be unreasonably withheld.
- 21.10 The issue of the Taking over Certificate shall in no way exempt the Contractor from the provisions of this Clause 21.
- 21.11 At the end of the Warranty Period, the liability of the Contractor shall cease



other than in respect of items which are subject to an Extended Defects Correction Period.

21.12 The Contractor shall provide, at the Site, at least one (1) control and instrumentation engineer, one (1) electrical engineer, one (1) mechanical engineer and one (1) operation expert during the Warranty Period without additional cost to the Owner.

21.13 The Contractor agrees that any item of Equipment replaced or rectified during the Warranty Period shall conform to the Technical Specifications of the corresponding original Equipment and if required by the Owner, the Contractor shall demonstrate such conformance through suitable means (to be decided by the Contractor at its sole discretion) including inspection by the Owner, shop testing or operation of the Equipment of which the replaced equipment/material constitutes a part.

21.14 WARRANTY FOR SPARES

In addition to the foregoing, the Contractor warrants that all spares supplied will be new and in accordance with the Contract and will be free from defects in design, material and workmanship and further guarantee as under:

For mandatory spares and two (2) years recommended spares:

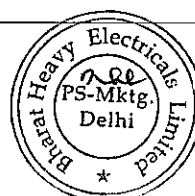
For item of spares ordered or to be ordered by the Owner for two (2) years operational requirement of the Plant which are manufactured as a continuous operation together with the corresponding main equipment/ component, the Warranty will be twelve (12) months from the Taking Over of the Plant under the Contract. In case of any failure in the original Equipment due to faulty designs, materials and workmanship, the corresponding spare parts if any, supplied shall be replaced without any extra cost to the Owner unless a joint examination and analysis by the Owner and the Contractor of such spare parts prove that the defect found in the original part that failed can safely be assured not to be present in spare parts. Such replaced spare parts will have the same Warranty as applicable to the replacement made for the defective original part/component.

21.15 Latent Defects:

Notwithstanding the issue of the Take Over Certificate, the Contractor shall be responsible for making good with all possible speed any Latent Defect in any Works /equipment of the plant which appears at any time before the expiry of defect liability period. And shall remedy such defect at its own cost and expense. The latent defect liability period shall be a minimum of 5 years from the end of defect liability period. The defects to which this applies are defects in design, materials or workmanship or defects arising from any act or omission of the Contractor done or omitted prior to Take-over of the portion of the Plant affected by the defects or during the Warranty Period which a reasonable examination at the end of the Warranty Period would not have disclosed.

22.0 DEFAULT OF CONTRACTOR

Termination upon Contractor's bankruptcy or default:



22.1 In the event the Contractor:

- (i) Contractor is adjudged a bankrupt or insolvent, or
- (ii) Contractor makes a general assignment for the benefit of its creditors, or
- (iii) A trustee or receiver is appointed for Contractor or for any of its property, or
- (iv) Contractor files a petition to take advantage of any debtor's act, or to reorganize under the bankruptcy or similar laws, or
- (v) Contractor fails to supply sufficient skilled workers or suitable materials or Equipment, or fails to commence the Work or abandons the Work or part thereof or fails to rectify any Work done that has been objected or rejected to by the Owner or if it fails to make prompt payments when due to Subcontractors or for labour, materials or equipment, or
- (vi) Contractor otherwise commits a material breach of any of the terms of the Contract,

Then Owner may, without prejudice to any other right or remedy Owner may have hereunder or at law or in equity, at any time terminate the Contract upon 30 days' notice to Contractor, provided such event or breach is not remedied within such 30 days period or, if the breach or default cannot reasonably be cured within 30 days, such longer period (not to exceed 90 days) as may be reasonably necessary to cure such breach or default. Owner may terminate the Contract immediately upon notice to Contractor if Contractor disregards a material provision of any Applicable Law. Owner may terminate the Contract, upon 30 days' notice, if Contractor disregards any other provision of Applicable Law, provided any such failure is not remedied within such 30 days period. Contractor shall receive no Termination Payment or other cancellation payments in the event of a termination under this clause, but Contractor shall be entitled to any part of the Contract Price then due and payable for the Works already performed.

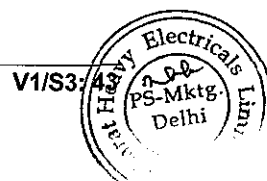
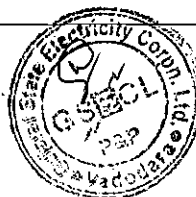
23. Not used

24. FORECLOSURE OF CONTRACT

Termination for Owner's Convenience:

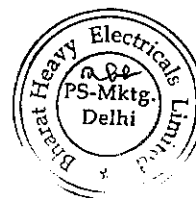
Owner may at will for its convenience at any time and without cause, terminate the Contract upon 30 days prior written notice to the Contractor.

Immediately upon receipt of such notice, Contractor shall stop performance of the Works, stop all further sub-contracting or purchasing activity, and terminate Sub-contracts; handover all Documents, equipment, materials and spares relating to the Works prepared by the Contractor or procured from other sources up to the date of termination for which the Contractor has received payment equivalent to the value thereof and shall immediately order & commence demobilization and remove all Contractor's Equipment, which is on Site and repatriate all his staff and labour from the Site.



Consequences of Termination.

- 24.1 Termination for Contractor's bankruptcy or default under Clause 22
- 24.1.1 In the case of termination by Owner for default or bankruptcy under the circumstances contemplated by Clause 22, Contractor shall not, pending settlement of Owner's claims by reason of such termination, be entitled to receive any further payment and shall protect, defend, indemnify and hold Owner harmless from and against all Losses arising directly or indirectly from or incurred by reason of such termination and, in any event, Owner shall not be liable to Contractor for any amount of the Contract Price in excess of the percentage of Work actually completed by the termination date multiplied by the Contract Price ("**Work Value**").
- 24.1.2 In addition, should the aggregate amount of the Contract Price actually paid prior to termination exceed the Work Value, Contractor shall pay to Owner an amount equal to such excess within thirty (30) days after receipt of an invoice from Owner therefor.
- 24.1.3 Accrued or actual or potential liabilities of Contractor under the Contract, for acts and omissions with respect to Work partially or fully completed at the time of termination shall not be affected by any such termination.
- 24.1.4 In furtherance of the foregoing, Owner shall have the right (either with or without the use of Contractor's Equipment) to finish the Work itself or with the assistance of third parties and Contractor shall be liable for the excess of the total cost of the Work actually incurred by Owner to all parties, persons or entities over the price for the Work originally contracted for hereunder.
- 24.1.5 In particular, to complete the Work, Owner shall have the right to take possession of and use, or to permit any third party to use, all Contractor's Equipment on or about the Site which are the property of Contractor. Rent for use of equipment by Owner and indemnification thereof shall be provided by GSECL.
- 24.1.6 Upon completion of the Work, all such Contractor's Equipment shall be returned to Contractor, subject to the right of Owner (which shall constitute a lien on such Contractor's Equipment) to sell the same and apply the proceeds to any claim which Owner may then have against Contractor.
- 24.1.7 Owner shall have the right at its sole discretion to select third parties to assist in or undertake such completion of the Work, such selection to be based upon such criteria as Owner shall determine.
- 24.2 Termination for Owner's Convenience under Clause 24
- Upon termination of the Agreement under Clause 24 (for Owner's Convenience), Contractor shall be entitled to be paid:
- (a) all actual documented costs incurred by Contractor, as audited and accepted by an independent certified public accounting firm of national reputation selected by Owner and acceptable to Contractor, incurred or that could not be avoided in connection with performance by Contractor



of Works as of the date of the Termination which were not previously paid for by Owner, and

- (b) all actual documented costs incurred by Contractor, if such cost is part of the Contract Price, in connection with the items procured/facilities executed by Contractor in connection with the services for which Contractor has not been paid, provided that such items are delivered to Owner at the Project Site together with all documents necessary to transfer title thereto to Owner (the 'Termination Payment').

As a condition precedent to receiving the Termination Payment, Contractor shall execute and deliver all such papers and take all such steps, including the legal assignment of Contractor's contractual rights, as Owner may require for the purpose of fully vesting in Owner all rights, title and interests of Contractor in and to all subcontracts, purchase orders, warranties, guarantees and other agreements.

All claims by such contractors and Subcontractors to be due and owing for Services and other work performed prior to such date shall constitute debts between Contractor and Subcontractors, and Owner shall in no way be liable for such sums. Contractor shall include in all agreements and contracts entered into with contractors and Subcontractors a provision providing for the foregoing.

- 24.3 Upon any termination aforesaid, Owner may at its option elect to (a) assume responsibility for and take title (to the extent title has not previously passed to Owner) to and possession of the Plant and any or all work, materials or equipment remaining at the Facility Site, and (b) succeed automatically, without the necessity of any further action by Contractor, to the interests of Contractor in any or all contracts and Subcontracts entered into by Contractor with respect to the Plant

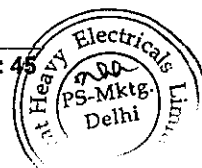
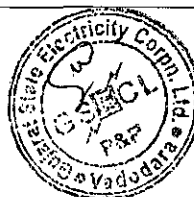
- 24.4 Surviving Obligations:

Termination of the Contract (a) shall not relieve either Party of its obligations with respect to the confidentiality of Proprietary Information as set forth elsewhere (b) shall not relieve either Party of any obligation hereunder which expressly or by implication survives termination and (c) except as otherwise provided in any provision of the Contract expressly limiting the liability of either Party, shall not relieve either Party of any obligations or liabilities for loss or damage to the other Party arising out of or caused by acts or omissions of such Party prior to the effectiveness of such termination or arising out of such termination and shall not relieve Contractor of its obligations as to portions of the Works already performed or of obligations assumed by Contractor prior to the date of termination.

- 24.5 Verification of the Termination:

Contractor shall, within 90 days of any such termination of the Agreement submit to Owner all invoices and other documentation as is sufficient to enable Owner to verify the performance of the Works and Contractor's costs associated therewith and to determine the amount of the Termination Payment. Termination Payment shall not include the costs of future anticipated profit or restocking charges.

Payment and Limitation of the Termination Payment. Owner shall pay the



Termination Payment to Contractor within 90 days of Owner's receipt of the documentation required under the clause: Verification of the Termination.

24.6 Limitation of Liability:

24.6.1 Payment of the Termination Payment shall be sole and exclusive liability of Owner, and the sole and exclusive remedy of Contractor, with respect to termination of the Contract pursuant to above clauses. In no event shall Owner have any further liability to Contractor in any such event for Consequential Damages.

24.6.2 (a) It is clarified here that except in cases of criminal negligence or wilful misconduct, the Contractor shall not be liable to the Owner, whether in contract, tort, or otherwise, for any indirect or consequential loss or damage, loss of use, loss of production, or loss of profits or interest costs, provided that this exclusion shall not apply to any obligation of the Contractor to pay liquidated damages to the Owner; and

(b) the aggregate liability of the Contractor to the Owner, whether under the Contract, in tort or otherwise, shall not exceed the total Contract Price, provided that this limitation shall not apply to any obligation of the Contractor to indemnify the Owner with respect to patent infringement.

For the avoidance of doubt it is hereby clarified that the Contractor's liability to pay the amounts pursuant to Clause 24.1.2 and/or Clause 24.1.4 shall not be excluded, or interpreted in any manner to be excluded under Clause 24.6.2(a) above, however such sums shall be considered towards the threshold for limitation of liability under Clause 24.6.2(b)

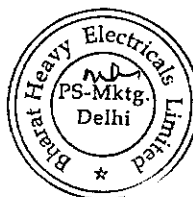
24.7 The Contract shall not be liable to be terminated except in accordance with the express provisions of the Contract.

25.0 **DEDUCTION FROM CONTRACT PRICE**

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 money 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.

26.0 **ASSIGNMENT OF CONTRACT**

The Contractor shall not assign its rights or obligations under the Contract without prior approval of the Owner. Any assignment in violation of this Clause shall be null and void. Further, such assignment, if approved by Owner, shall not relieve the Contractor from any obligations, duty, or responsibility under the Contract.



27.0 **SUBCONTRACTING**

27.1 Equipment

The Contractor may, after informing the Owner and getting his Approval, assign or subcontract any part of the Contract other than for raw materials, to manufacturers which are identified in Schedule [insert] of the Contract. Sub-contractor(s) not identified in Schedule [insert] of the Contract or any change in the identified sub-contractor(s) shall be subject to approval by the Owner. Provided that subcontracting shall not relieve the Contractor from any obligation, duty or responsibility under the Contract. Provided further that subcontracting to any subcontractor other than those identified in Schedule [insert] without prior approval of the Owner shall be null and void.

27.2 Erection Work

When the job of erection/construction is entrusted with the sub-contractor(s) the name/names of such sub-contractor(s) shall be approved by the Owner as elaborated above. Such subcontracting shall not relieve the Contractor from any obligation, duty or responsibility under the Contract.

27.3 Notwithstanding anything to the contrary contained herein, the Contractor shall remain solely responsible for and shall obtain all permits, licenses, approvals and authorisation as may be required under all applicable laws and regulations in India in respect of any award or performance of any transfer, sub-contract, sub-letting or assignment pursuant hereto.

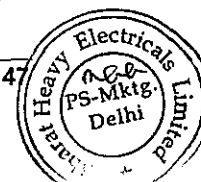
27.4 Notwithstanding any transfer, assignment or sub-letting with the approval of the Owner as aforesaid, the Contractor shall be and shall remain solely responsible and liable to the Owner for the quality, proper and expeditious execution and performance of the Works and for due performance and observance of all the conditions of the Contract in all respects, as if such transfer, assignment or sub-letting has not taken place and as if the Work so transferred, assigned or sub-let has been done directly by the Contractor.

28.0 **FORCE MAJEURE**

"Force Majeure Event" shall mean any event or circumstance or combination of events or circumstances referred to below that wholly or substantially prevents or unavoidably delays any Party in the performance of its obligations under the Contract, but only if and to the extent that such events and circumstances are not within the reasonable control, directly or indirectly, of the affected Party and could not have been avoided if the affected Party had taken reasonable care.

(a) Any cause which is beyond the control of Contractor or Owner, as the case may be (b) natural phenomenon including but not limited to weather conditions, floods, drought, earthquakes and epidemic (c) acts of any Governmental authority (domestic), including but not limited to war (declared or undeclared), revolution, quarantine, embargoes, licensing control or production or distribution restrictions (d) sabotage, riots and civil commotion (e) Nation wide or wide spread strikes or labour disputes extending beyond the Project site. (f) failure or delay in Contractor's source of supply due to force majeure causes enumerated at (a) to (e), provided that the Contractor proves to the satisfaction of the Owner that the supply from the alternate sources were not possible.

Any force majeure event which affects the Contractor's joint venture



partners/collaborators/joint venture company, who have executed the JDU, and which event satisfies the requirements of Clause 28 shall be treated as a "Force Majeure Event"

The following events are explicitly excluded from Force Majeure Events and are solely the responsibility of the affected party:

- i) any strike, work-to-rule action, go-slow, or similar labour difficulty which is not specifically, enumerated in the above clauses (a) to (f);
- ii) late delivery, of plant, machinery, equipment, materials, spare parts or Consumables for the Plant;
- iii) a delay in the performance of any contractor;
- iv) economic hardship;
- v) changes in Applicable Laws;
- vi) Force Majeure events which occur outside India and do not directly involve India comprising: (x) act of war (whether declared or undeclared), invasion armed conflict or act of foreign enemy blockade, embargo, resolution, riot, insurrection, civil commotion, act of terrorism, or politically motivated sabotage or kidnapping or (y) any event or circumstance of a nature analogous to any of the foregoing.

If the Contract is delayed or impeded in the execution of the work by circumstances of Force Majeure as herein defined, then the Contractor/Owner as the case may be, shall, within one week, give notice in writing to the Owner/ Contractor, of the existence of circumstances of Force Majeure, together with the evidence relied upon.

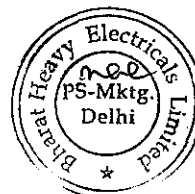
Burden of Proof: In the event that the Parties are unable in good faith to agree that a Force Majeure Event has occurred, the Parties shall submit the dispute to arbitration, provided that the burden of proof as to whether a force Majeure event has occurred shall be upon the Party claiming a Force Majeure Event.

Effect of Force Majeure : Neither party shall be considered to be in default or in breach of his obligations under the Contract to the extent that performance of such obligations is prevented by any circumstances of Force Majeure which arise after the Commencement Date.

In the event that Force Majeure circumstances continue for a period of more than one month, both the parties may discuss and mutually agree upon the future course of action which may include termination of Contract.

The Contractor shall request for extension of Time for Completion due to delay caused by Force Majeure. The Owner may agree to give extension in time as may be justified. However the Owner will not bear any additional cost whatsoever in connection with Force Majeure.

Performance to Continue : Upon the occurrence of any circumstances of any Force Majeure the Contractor shall endeavor to continue to perform his obligations under the Contract so far as reasonably practicable. The Contractor shall notify the Engineer of the steps he proposes to take including any reasonable alternative means for performance which is not prevented by Force Majeure. The Contractor shall not take any such steps unless directed so to do by the Engineer.



29.0 **PROGRESS REPORTS AND PHOTOGRAPHS**

The Contractor shall furnish three (3) prints each of monthly Progress Reports with photographs of the Works done in his shop . Photographs shall be taken when and where requested by the Owner. Adequate number of photographs shall be submitted indicating various stages of manufacture. Each photograph shall contain the date, the name of the Contractor and the title of the view taken.

Monthly Progress Report shall be submitted by the Contractor. These shall detail the status of design, drawings, procurement of raw materials and manufacture of the equipment and delivery of the equipment. The Owner shall advise the Contractor about the number of copies of progress schedule and photographs he has to submit each month together with the names and addresses of persons to whom they are to be sent. The Contractor shall also furnish actual progress against Works schedule and such other information as the Owner may require to satisfy himself about the timely manufacture and delivery of equipment and timely construction and erection works to suit the commissioning date.

30.0 **CONFIDENTIALITY AND PATENT RIGHTS**

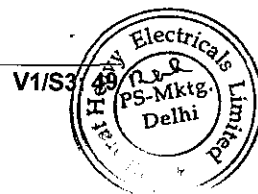
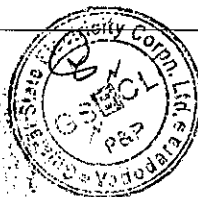
30.1 The Owner and the Contractor shall not, without the written consent of the other Party hereto, divulge to any third party any Confidential Information furnished directly or indirectly by the other Party hereto in connection with the Contract, whether such Confidential Information has been furnished prior to, during or following termination of the Contract. Notwithstanding the above, the Contractor may furnish to its Sub-contractor(s) such Confidential Information that it receives from the Owner to the extent required for the Sub-contractor(s) to perform its work under the Contract, in which event the Contractor shall obtain from such Sub-contractor(s) an undertaking of confidentiality similar to that imposed on the Contractor under this Clause 30.1.

Notwithstanding the above, the Owner may furnish any Confidential Information and other information it receives from the Contractor, to its lenders, other financing parties and to its professional advisors to the extent the same is required directly in relation to the Project or financing of the Project, in which event the Owner shall obtain from such lenders, other financing parties and professional advisors, an undertaking of confidentiality similar to that imposed on the Owner under this Clause 30.1

30.2 Save as provided above, the Owner shall not use the Confidential Information received from the Contractor for any purpose other than the operation and maintenance of the Plant. Similarly, the Contractor shall not use the Confidential Information received from the Owner for any purpose other than the design and procurement of the Plant and Equipment, construction and commissioning of the Facility and provision of other services required for the performance of the Contract

30.3 The obligation of a Party under sub-Clauses 30.1 and 30.2 above, however, shall not apply to the Confidential Information which:

(a) now or hereafter enters the public domain through no fault of that Party



(b) can be proven to have been possessed by that Party at the time of disclosure and which was not previously obtained, directly or indirectly, from the other Party hereto

(c) otherwise lawfully becomes available to that Party from a third party that has no obligation of confidentiality

30.4 The provisions of this Clause 30 shall not in any way modify any undertaking of confidentiality given by either Party prior to the date of the Contract in respect of the Facility or any part thereof

30.5 The Contractor shall indemnify and hold harmless the Owner and its employees and officers from and against any and all suits, actions or administrative proceedings, claims, demands, losses, damages, costs, and expenses of whatsoever nature, including attorney's fees and expenses, which the Owner may suffer as a result of any infringement or alleged infringement of any patent, utility model, registered design, trademark, copyright or other intellectual property right registered or otherwise existing at the date of the Contract by reason of: (a) the installation of the Facility by the Contractor or the use of the Facility in India; and (b) the sale of the power produced by the Facility in India.

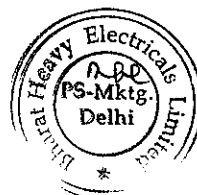
Such indemnity shall not cover: (i) any use of the Facility or any part thereof other than for the purpose indicated by or to be reasonably inferred from the Contract; and (ii) any infringement resulting from the use of the Facility or any part thereof, or the power produced thereby in association or combination with any other equipment, plant or materials not supplied by the Contractor, pursuant to the Contract

30.6 If any proceedings are brought or any claim is made against the Owner arising out of the matters referred to in sub-Clause 30.5, the Owner shall promptly give the Contractor a notice thereof, and the Contractor may at its own expense and in the Owner's name conduct such proceedings or claim and enter into any negotiations for the settlement of any such proceedings or claim.

If the Contractor fails to notify the Owner within twenty-eight (28) days after receipt of such notice from the Owner that it intends to conduct any such proceedings or claim, then the Owner shall be free to conduct the same on its own behalf. Unless the Contractor has so failed to notify the Owner within the twenty-eight (28) day period, the Owner shall make no admission that may be prejudicial to the defense of any such proceedings or claim.

The Owner shall, at the Contractor's request, afford all available assistance to the Contractor in conducting such proceedings or claim, and shall be reimbursed by the Contractor for all reasonable expenses incurred in so doing.

30.7 The Owner shall indemnify and hold harmless the Contractor and its employees, officers and Sub-contractors from and against any and all suits, actions or administrative proceedings, claims, demands, losses, damages, costs, and expenses of whatsoever nature, including attorney's fees and expenses, which the Contractor may suffer as a result of any infringement or



alleged infringement of any patent (excluding any infringement or alleged infringement of any patent under Clause 30.5), utility model, registered design, trademark, copyright or other intellectual property right registered or otherwise existing at the date of the Contract arising out of or in connection with any design, data, drawing, specification, or other documents or materials provided or designed by or on behalf of the Owner (other than by the Contractor).

Such indemnity shall not cover: (i) any use of the design, data, drawing, specification, or other documents or materials or any part thereof other than for the purpose indicated by or to be reasonably inferred from the Contract; and (ii) any infringement resulting from the use of the design, data, drawing, specification, or other documents or materials or any part thereof in association or combination with any other design, data, drawing, specification, or other documents or materials not supplied by the Owner, pursuant to the Contract.

30.8 The provisions of this Clause 30 shall survive termination, for whatever reason, of the Contract

31.0 **BANKRUPTCY, ETC.**

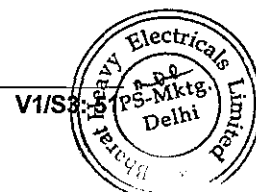
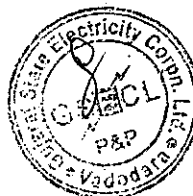
If the Contractor commits any act of bankruptcy or goes into liquidation (except for reconstruction purposes) or carries on its business under a receiver, the executors, successors, or other representatives in law of the estate of the Contractor or any such receiver, liquidator, or any person in whom the Contract may become vested, shall forthwith give notice thereof in writing to the Owner and shall for one month, during which he shall take all reasonable steps to prevent a stoppage of the work, have the option of carrying out the Contract subject to his or their providing such guarantee as may be required by the Owner but not exceeding the value of Works for the time being remaining unexecuted, provided however that nothing above said shall be deemed to relieve the Contractor or its successor of its obligation under the Contract under any circumstance. In the event of stoppage of the Works the Period of the option under this clause shall be fourteen (14) days only, provided that, should the above option be not exercised, the Contract may be terminated by the Owner by notice in writing to the Contractor, and the same power and provision reserved to the Owner by the item Default of Contractor shall apply.

32.0 **INDEMNIFICATION OF THE OWNER**

32.1. The Contractor shall indemnify the Owner of all liabilities incurred by the Owner due to any act or omission on the part of Contractor, his agent, representative, or sub-contractor(s) and causes harm/damage to other Contractor/representatives of the Owner or all or anybody rendering service to the Owner or is connected with the Owner's work in any manner whatsoever. The Contractor shall necessarily indemnify the Owner in all these respects.

The indemnity under this clause shall include all costs, charges, expenses on account of any claims, demands, actions and proceedings against the Owner in respect of such injuries, loss or damage.

32.2 Indemnification of the Contractor



The Owner shall fully indemnify, save harmless and defend the Contractor from and against any and all costs, charges, expenses on account of any claims, demands, actions and proceedings arising out of or resulting from claims by any third parties arising out of or related to the performance of Owner's obligations pursuant to this Contract to the extent caused by any act or omission on the part of the Owner, his agent, representative, or sub-contractor(s), provided that the foregoing obligation shall not apply to the extent such liabilities are caused by the acts or omissions of the Contractor, its agent, representative, or sub-contractor(s)

33.0 **CORRESPONDENCE**

The correspondence procedure will be developed mutually by the Owner and Contractor after award of Contract.

34.0 **CONTRACT AGREEMENT**

- a) The Successful Bidder will be called for Contract negotiations. A signed provisional Contract Agreement will be forwarded by the Bidder which shall be mutually discussed. The acceptable provisional agreement will be concluded within thirty (30) days. On receipt of this, the Owner will issue Notice to Proceed to Bidder. The final Agreement in six (6) originals shall be produced by the Contractor at his cost for signing within sixty (60) days.

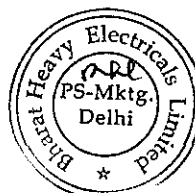
The Agreement will be signed in six (6) originals and the Contractor shall be provided with one (1) signed original and the rest will be retained by the Owner. The Contractor shall provide free of cost to the Owner all the engineering data, drawings and descriptive materials submitted with the Tender, complete set of his Tender and Tender Documents, copies of all the correspondences with the Owner, etc. in six (6) copies to form a part of the Contract Documents.

b) **Contract Documents**

These Contract Conditions together with the Specification, Tender drawings and guaranteed technical particulars, Tender data with subsequent agreed modification thereof, Tender, all correspondences with the Owner and Signed Agreement and other supporting documents shall constitute the Contract Document(s). No variation or modification or terms and conditions of the Contract Documents or waiver of any of these terms and conditions shall be deemed valid unless agreed in writing and signed by the Owner and the Contractor.

c) **Endorsement of Terms**

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



35.0 NOTICE TO PROCEED AND EFFECTIVE DATE

35.1 Contractor shall commence Performance of Work on the date which the Owner specifies in Notice to Proceed (NTP) delivered for Commencement of the work (the "Commencement Date") which shall not be earlier than the date of issue of the Notice to Proceed. The Contractor shall perform its obligation in a manner that would ensure that the Commercial Operation of the Plant occurs within the Guaranteed Commercial Operation Date.

Before issue of NTP following conditions are to be complied with.

- (i) Signing of the Contract.
- (ii) Release of Advance payment.
- (iii) Unhindered & unencumbered access to the site as is where is basis

GSECL will issue LOA after ensuring issuance of NTP within 60 (sixty) days

35.2 The Contract shall come into force on the date of Notice to Proceed.

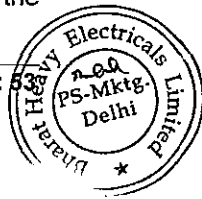
36.0 USE OF THE PLANT PRIOR TO OWNER ACCEPTANCE

Owner reserves the right to take possession of and use for any intended purpose, any portion or all of any delivered but as yet unaccepted Plant. The taking of possession at any time or use of any of such portion of Plant shall not be deemed to be an acknowledgement of Owner acceptance of Unit or the Plant, and shall not be exclusive with respect to Contractor until Owner acceptance of the Plant, has occurred. Owner shall provide Contractor with reasonable and timely access to complete its obligations hereunder. It is the expectation of the parties that any such modifications or repairs will be accomplished by Contractor with minimal interference with operation of the Plant.

37.0 INSURANCE

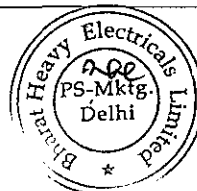
37.1 The Contractor at his cost shall arrange, secure and maintain all insurance as may be pertinent to the Works and obligatory in terms of law to protect his interest and interests of the Owner against all perils detailed herein. MCE (Marine cum Erection comprehensive) insurance for the plant and equipment under contractor's scope shall be effective from the date of mobilization of site by the contractor. The form and the limit of such insurance as defined herein together with the underwriter in each case shall be as acceptable to the Owner. However, irrespective of such acceptance the responsibility to maintain adequate insurance coverage up to commercial Operation date shall be the Contractor's full responsibility. The Contractor's failure in this regard shall not relieve him of any of his contractual responsibilities and obligations. The insurance policies to be taken by the Contractor shall be in a joint name of the Owner and the Contractor. The Contractor shall, however, be authorised to deal directly with Insurance Company or Companies and shall be responsible in regard to maintenance of all insurance covers.

37.2 Any loss or damage to the equipment during handling, transportation, storage, erection, putting into satisfactory operation and all activities to be performed till such time the Plant is finally accepted by the Owner shall be to the account of the Contractor. The Contractor shall be responsible for raising of all claims and make good for the damage or loss by way of repairs and/or replacement 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 copy of all insurance policies and documents taken out by him in pursuance of the Contract. Such copies of documents shall be submitted to the Owner immediately after such insurance coverage. The Contractor shall also inform the Owner in writing at expiry/cancellation and/or change in any of such documents and ensure revalidation, renewal, etc. as may be necessary well in time.

- 37.3 Licenses/port clearances in respect of supplies to be made by the international Contractor from outside India required for purpose of replacement of equipment lost in transit and/or during storage shall be obtained by the Contractor on behalf of the Owner. The Contractor shall, however, be required to follow the procedure as may be laid down to facilitate arranging such licenses/clearances.
- 37.4 The perils required to be covered under the insurance shall include, but not limited to fire and allied risks, miscellaneous accidents (erection risks), workmen compensation risks, loss or damage in transit, theft, pilferage, riot and strike and malicious damages, civil commotion, weather conditions, accidents of all kinds, war risks (during ocean transportation only), Terrorism etc. Further insurance cover towards contamination from nuclear fuel/waste and ionizing radiations/radioactive is not envisaged. The scope of insurance shall be equivalent to the CIF value of equipment plus ten percent (10%) for all risks up to and including delivery of the equipment on CIF basis and for CIF value plus custom duty (as applicable on the cost of replacement) and additional ten percent (10%) of CIF value for all risks subsequent to delivery of goods on CIF Indian port basis. In case of indigenous supply, the scope of insurance shall be equivalent to FOR Site price inclusive of all Taxes plus ten percent (10%) for all risks. For the risks during the erection, the insurance cover to be taken shall be of appropriate value adequate to take care of all costs incurred till the erection. The insurance policies to be taken should be on replacement value basis including the Taxes (as applicable) on the replacement value. Notwithstanding the extent of insurance cover and the amount of claim available from the underwriters, the Contractor shall be liable to make good the full replacement/rectification value of all equipment and materials and to ensure their availability as per project requirements.
- 37.5 All costs on account of insurance liabilities covered under the contract will be included in Contract Price. However, the Owner may from time to time, during the pendency 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 amount. The Contractor, while arranging the insurance, shall ensure to obtain all discounts on premium which may be available for higher volume or for reason of financing arrangement of the Plant.
- 37.6 The Contractors shall ensure that for all activities to be performed in India viz. inland transportation, storage, erection, testing, commissioning, theft, pilferage, etc. till the equipment/plant is taken over by the Owner, the insurance cover shall only be taken from Indian Insurance Companies.
- 37.7 The clause entitled "Insurance" under the Section 4 of this Volume, covers the Additional insurance requirements for the portion of the Works to be performed at the Site.
- 37.8 In respect of insurance proceeds/claim settlements relating to claims raised/referred by the Contractor, the Owner shall give, from time to time, written



authorisation to the underwriter(s) to directly pay such proceeds/settlements to the Contractor as are in accordance with the provisions hereunder:

i) Wherever total damage/loss of equipment/materials would occur, the Contractor will be entitled to payments received from the underwriters except the following amounts :

a) The amount paid to the Contractor under the Contract in respect of equipment/material damaged/lost (excluding the prorata Advance Payment).

b) Taxes which have already been paid by the Owner.

Subsequent payments, if any, due under the Contract shall be regulated by the relevant terms of payment, provided the claim money settled by the underwriter is more than the total of the amount as per (a) and (b) above. In the event of the claim money settled is less than the total of the amount in (a) and (b) above, the entire claim money settled will be retained by the Owner and the Contractor will forthwith pay the Owner the shortfall amount between the claim money and the total amounts as per (a) and (b) mentioned above.

ii) In case of damage to any equipment/material during any stage, the Contractor upon rectification of the damaged equipment to the satisfaction of the Owner shall be paid to the extent of full claims settled by the underwriters. Subsequent payments, if any, due under the Contract shall be regulated by the relevant terms of payment.

37.9 The Contractor shall be responsible for making good any loss or damage at his own cost in a prompt manner, irrespective of the extent of settlement of claims by the insurers/underwriters or the time taken in settlement of such claims.

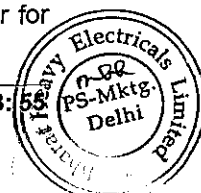
37.10 The Contractor shall ensure adequacy of the value of insurance covers irrespective of the coverage indicated under this clause.

38.0 CONTRACTOR'S CARE OF THE WORKS

38.1 The Contractor shall take full responsibility for the care of the Works from the Notice to Proceed until the date of issue of the Take Over Certificate when responsibility shall pass to the Owner. If the Owner's representative issues a Take Over Certificate for part of the Works, the Contractor shall cease to be responsible for the care of that part from the date of issue of such certificate of Take Over when responsibility shall pass to the Owner.

38.2 The Contractor shall take responsibility for the care of any outstanding Work which is required to be completed prior to the expiry of the Contract Period, until the Owner's representative confirms in writing that such outstanding work has been completed.

38.3 If any loss or damage happens to the Plant, during the period for which the Contractor is responsible, the Contractor shall rectify such loss or damage, at his cost, so that the Works conform with the Contract. Without prejudice to any other obligation of the Contractor under the Contract, the Contractor shall also be liable for any loss or damage to the Works caused by operations carried out by the Contractor prior to the expiry of the Contract Period in so far as such loss or damage is not covered under Insurance to be taken by the Owner for

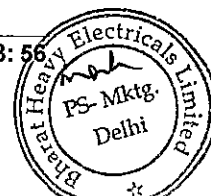
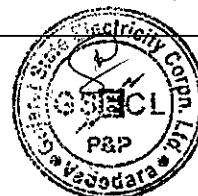


operation of Plant.

39.0 **ARBITRATION AND JURISDICTION**

39.1 **Arbitration**

- a) The Parties shall negotiate in good faith and attempt to resolve any dispute, controversy or claim arising out of or relating to the Contract or the breach, interpretation, termination or validity thereof (a "Dispute"); provided, however, that if the Parties are unable to resolve a Dispute within a period of [30] days from the date of first occurrence of the Dispute, such Dispute shall be settled by valid and binding arbitration conducted by three arbitrators in accordance with the UNCITRAL (United Nations Commission on International Trade Law) rules.
- b) If a Dispute is not resolved by the good faith negotiation of the Parties, either Party may serve upon the other a written demand that such matter be resolved through arbitration, which written demand shall include a brief description of the Dispute and shall specify the name and address of an arbitrator selected by it. The other Party shall within 20 days of receipt of the arbitration demand select its arbitrator and provide the name and address of such arbitrator to the demanding Party and its arbitrator. The two selected arbitrators shall within 15 days of the selection of the second arbitrator select the third arbitrator, failing to do so, the arbitrators shall request the President of International Chamber of Commerce (ICC), promptly to appoint the third arbitrator in good standing of its association as the third arbitrator in accordance with ICC Appointing Authority Rules, 2003. Related costs of such appointment shall be borne by the defaulting party for the appointment of its arbitrator.
- c) The place of arbitration shall be Vadodara, Gujarat , India and the law applicable to the arbitration procedure shall be UNCITRAL. The English language shall be used throughout the arbitrage proceedings. Each Party shall bear its own arbitration proceeding expenses, including but not limited to counsel fees, except common expenses of arbitration which shall be shared equally. The Parties and the arbitrators shall proceed with the arbitration expeditiously and shall to the best of their ability conclude all proceedings there under, including any hearings, in order that a decision may be rendered by the arbitrators within 120 days from the filing of the demand for arbitration by the demanding Party.
- d) The decision of any two of the three arbitrators shall be final and binding. The parties agree that the decision and any award rendered by the arbitrators in connection with a Dispute :
 - i) Shall be final and binding on the Parties and may be enforced in any court having jurisdiction over the Party against which enforcement is sought;
 - ii) Shall be the sole and exclusive remedy between the Parties regarding the Dispute and any claims, counterclaim issues or accountings presented or pled to the arbitrators in connection with the arbitration of the Dispute; and
 - iii) In the case of an award, shall be made and promptly paid in



Rupees free of any tax, deduction or offset.

Any costs, fees or taxes incident to enforcing the decision or award shall be charged against the party resisting such enforcement. Any award shall include interest from the date of any damages incurred for breach or other violation of the Agreement, and from the date of the award until paid in full, at a rate to be fixed by the arbitrators.

- e) The provisions of this Clause shall survive the termination or expiration of the Contract. All notices by one Party in connection with an arbitration shall be delivered in accordance with instructions.
- f) The arbitrator shall have full powers to review and/or revise any decision, opinion, directions, certification or valuation of the Owner in consonance with the Contract, and neither party shall be limited in the proceedings before such arbitrators to the evidence or arguments put before the Owner for the purpose of obtaining the said decision.
- g) No decision given by the Owner in accordance with the foregoing provisions shall disqualify him as being called as a witness or giving evidence before the arbitrators on any matter whatsoever relevant to the dispute of difference referred to the arbitrators as aforesaid.
- h) Performance of the Contract shall continue during arbitration proceeding unless the Owner shall order the suspension thereof or any part thereof and if any such suspension shall be added to the Contract Price. No payments due or payable by the Owner shall be withheld on account or a pending reference to arbitration.

39.2 Subject to Clause 39.1 above, the Courts at [Gujarat] shall have the exclusive jurisdiction on any matter arising out of, under or in relation to the Contract.

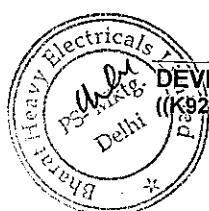
40.0 **SUSPENSION OF WORK**

40.1 Owner's Right to Suspend:

40.1.1 Owner may at any time and from time to time and for any reason, by written notice to the Contractor, suspend furtherance performance of all or any part of the Works hereunder upon 10 days' prior written notice to Contractor (or, in emergency situations, upon such prior notice as circumstances permit) indicating (a) the portion of the Works the completion of which Owner has elected to defer, (b) Owner's estimate of the duration of such suspension, and (c) the effective date of such suspension of the Works.

Upon receipt of and consistent with the effective date of such notice, Contractor shall:

- (a) stop performance of further Works which Owner has elected to defer and shall continue to complete performance of the balance of the Works. During the period of such suspension Contractor shall properly care for and protect all Work in progress and all property of Owner which pursuant to the terms of the Contract is subject to the supervision of Contractor in whatever state of completion;
- (b) place no further subcontracts or purchase orders for materials, services, work or facilities in respect of the Work except to the extent expressly



DEVELOPMENT CONSULTANTS
(K9213R_EPC-SPC-001_V1_S3.doc) July 09 2012)



V1/S3: 57

requested by Owner; and

- (c) unless otherwise directed by Owner, use all reasonable endeavours to suspend on the most favourable terms available to Contractor all purchase orders, subcontracts and rental and lease agreements to the extent affected by such suspension and otherwise minimise any additional costs associated with such suspension.

40.1.2 Contractor shall promptly deliver to Owner copies of all such Work in progress and all such property as may be requested by Owner & mutually agreed. Owner may at any time terminate the suspension by written notice to Contractor specifying the effective date of termination and Contractor shall use its best efforts to resume performance of its obligations pursuant to the Contract immediately upon receipt of such notice. During the suspension period, the Contractor shall not be allowed to take all such properties outside the plant premises without Owner's permission.

40.1.3 During a suspension, Contractor shall not be entitled to payment of the Contract Price which would have otherwise been ordinarily payable during the relevant period of such suspension, except for such part of the Work which has been completed prior to the date of suspension specified in the notice of suspension.

40.1.4 Upon resumption by Contractor of all activities affected by a suspension, Owner shall resume payments of the Contract Price (it being understood that no interest shall be payable in respect of such resumed payments) with the payment dates therein adjusted to reflect the period during which scheduled payments were not made.

40.2 Consequences of Suspension

40.2.1 Owner's instructions under Clause 40.1 shall be treated as instructions to carry out a change under Clause 4.4, except to the extent that the suspension instructed by Owner is necessary by reason of default, breach, failure or non-performance on the part of Contractor.

40.2.2 To the extent such instructions are treated as a request for a change under Clause 4.4 in accordance with the immediately preceding Clause 40.2.1, Contractor shall be entitled to submit to Owner a preliminary change order for a determination of an adjustment Guaranteed Commercial Operation Date, the Contract Price, the payment and milestone Schedule, the Project Schedule and the Performance Guarantees, as appropriate. Contractor shall mitigate to the fullest extent reasonably possible any additional expenses to be borne by Owner as a result of suspension of the Works pursuant to this clause.

40.2.3 Except as provided in this Clause 40.2.2 Contractor shall have no claim against Owner.

40.3 Contractor's Right to Suspend.

The Contractor shall have the right to suspend the relevant Works, for the reasons mentioned below, by giving twenty one (21) days' notice to the Owner upon occurrence of the following reasons:

- (a) If the Owner has failed to pay the Contractor, without reasonable cause, any

sum due to the Contractor under the Contract within thirty (30) days after the expiry of time within which payment of such amount was required to be made under the Contract;

- (b) If the Contractor is unable to carry out any of its obligations under the Contract for reasons solely attributable to the Owner, including but not limited to the Owner's failure to provide access to Site or failure to obtain any Applicable Permit necessary for the execution and/or completion of the Facility which the Owner is required to obtain as per the provisions of the Contract or as per Applicable Laws,

If the Contractor's suspends performance of the Works or the rate of progress is reduced pursuant to this Clause 40.3, then the Time for Completion shall be extended, and any and all additional costs or expenses incurred by the Contractor as a result of such suspension or reduction in the rate of progress shall be paid by the Owner to the Contractor in addition to the Contract upon resumption of Works, except where the suspension of the Works or reduction in the rate of progress is attributable to the Contractor's default or breach of Contract.

41.0 TRAINING OF OWNER'S PERSONNEL

The Contractor shall furnish all manuals, documentation and train Owner's Engineers/Personnel free of cost for safe, successful and reliable operation of the plant (for minimum 60 people).

The Contractor shall undertake to train free of charge, Engineering personnel selected and sent by the Owner at the works of the Contractor (not less than 60 man month duration). 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 in their Collaborator's works and in any other plants where equipment manufactured by the Contractor or his Collaborator is under installation/operation or testing to enable those personnel to become familiar with the equipment being furnished by the Contractor.

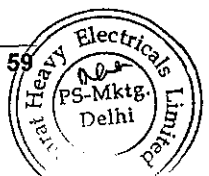
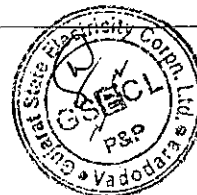
All traveling expenses for the engineering personnel to be trained during the total period of training will be borne by the Owner. However, the Contractor shall provide necessary accommodation and local transport for such personnel.

The Contractor shall also train Owner's Operation & Maintenance personnel to become proficient in operating the equipments and for routine maintenance/repair/replacement, lubrication, overhauling, adjustments, testing etc. of the plant and equipments.

42.0 AS-BUILT DRAWINGS

The Contractor shall furnish drawings and document in as-built condition as stipulated in the Specification.

On completion of the project, contractor should submit Three Sets of As commissioned drawings, Three Sets of as Installed Bill of Materials and Three Sets of As Commissioned Data/ Specification /Parameter Sheets Duly Signed



by the Competent Authority. (Note: This was earlier at definition of drg sr no (f)
CI 2.1)

43.0 REJECTION OF DEFECTIVE PLANT

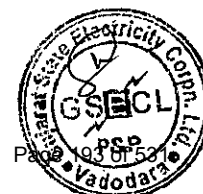
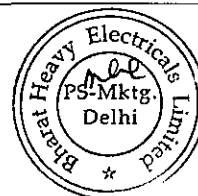
43.1 Without prejudice to the rights of the Owner elsewhere in the Contract, if the completed Plant or any portion thereof, before it is Taken Over under Clause "Taking Over" or during the Warranty Period, is found defective or fails to fulfill the requirements of the Contract, the Engineer shall give the Contractor notice setting forth particulars of such defects or failure, and the Contractor shall forthwith make the defective Plant good or alter the same to make it comply with the requirements of the Contract. Should he fail to do so within seven (7) days, the Owner after giving seven (7) days written notice may reject and replace at the cost of the Contractor the whole or any portion of the Plant, as the case may be, which is defective or fails to fulfill the requirements of the Contract.

43.2 In the event of such rejection, the Owner shall have the right to operate any and all Equipment and/or Plant as long as it is in operating conditions, whether or not, such Equipment has been accepted as complete and satisfactory, to enable him to obtain necessary replacement except that this shall not be construed to permit operation of any equipment which may become damaged by such operation before any required alterations or repairs and/or replacements have been made. All repairs or alterations or replacement required of the Contractor shall be made by the Contractor at such times as directed and in such a manner as will cause the minimum interruption in the use of the equipment by the Owner. Should the Contractor not so replace the rejected plant within the time frame as directed by the Engineer, up to the requirements of the Specification, the Contractor's full and extreme liability under this Clause will be satisfied by the repayment of all money paid by the Owner to him in respect of such plant plus dismantling, site clearance and disposal costs or should be replacement cost whichever is higher.

43.3 Nothing in this Clause shall be deemed to deprive the Owner or, effect any right under the Contract which he may otherwise have in respect of such defects or deficiencies or in any way relieve the Contractor of his obligation under the Contractor. Further, this Clause shall be in addition to and not in derogation of any other right of the Owner under the Contract.

44.0 MOST FAVOURED CUSTOMER

The Contractor agrees that Owner is and throughout the implementation of the Works will be "the most favoured customer" of the Contractor and all its Associates. As such, Contractor confirms and agrees that no other customer of the Contractor or its Associates will receive greater priority including provision of project personnel, resources and systems than Owner and Contractor hereby assures Owner that the successful, efficient and effective implementation of the Works is and will be the most important customer activity of Contractor and all its affiliates and associates. Contractor and all its affiliates shall not undertake any other project anywhere in the world if to do so, reasonably could be expected to have an adverse effect on the implementation of the Works.



45.0 **CONTRACTOR'S ACCEPTANCE OF THE WORK AND SITE**

45.1 **Acceptance of the Work Generally**

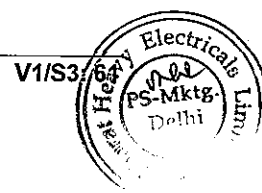
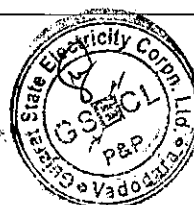
Contractor acknowledges that it has:

- (1) Entered into the Contract for the consideration set forth in the Contract and after due and careful inquiry.
- (2) Satisfied itself in respect of all pertinent matters which may bear upon the performance of the Contract and the Work, including:
 - (a) The nature and magnitude of the Work;
 - (b) The Applicable Laws and all environmental risks, conditions and applicable restrictions;
 - (c) The calculation and sufficiency of the Contract Price;
 - (d) Achievement of the Commercial Operation and Performance Guarantees;
 - (e) Quality and quantity of the Equipment and Contractor's Equipment required for the performance of the Work;
 - (f) Access to the Site;
 - (g) Availability of all labour and personnel;
 - (h) The character and quality of the Work to be performed;
 - (i) General and local conditions;
 - (j) Disposal, handling and storage of materials;
 - (k) All other pertinent, relevant or related matters and conditions.

45.2 **Acceptance of the Site:**

Bidder acknowledges that:

- (1) The Plant shall be designed and engineered for erection and installation and performance in accordance with the Contract at the Site; and
- (2) Bidder has satisfied itself as to all general, local and groundwater conditions at the Site and the areas adjacent thereto, including but not limited to:
 - (a) Sea, river and land transportation and access and right of way to the Site, including the availability and condition of roads and ports and rights-of-way, conditions affecting transportation, access and egress;
 - (b) Handling and storage of materials;
 - (c) Availability and quality of labour, sand, and rock;



- (d) Rainfall and other climatic conditions, tides, currents, soundings and ground water and other hydrological conditions (including the monsoons);
- (e) Topography, ground surface, subsurface
- (f) Equipment required by Bidder prior to and during performance of its obligations hereunder;
- (g) Availability of housing and other relevant social and urban infrastructure;
- (h) Any and all other pertinent, relevant or related matters and conditions.

45.3 No Claim for Actual Conditions

Contractor acknowledges that all appropriate allowances for the matters and conditions referred to in Articles 45.1 and 45.2 and those pertaining to the Work or to the Contract generally have been taken into account in calculating the Contract Price, and the other terms and conditions of the Contract.

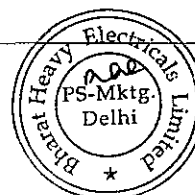
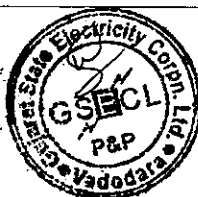
Contractor's failure to acquaint itself and consider any applicable condition, situation, requirement or other matter referred to in Articles 45.1 and 45.2 and those pertaining to the Work or to the Contract generally, will neither relieve it from the responsibility for successfully performing the Contract, nor entitle the Contractor to a Change Order, adjustment of Contract Price or Guaranteed Commercial Operation Date for reasons relatable to such failure.

45.4 Except as otherwise expressly stated in the Contract:

- (1) Contractor shall be deemed to have obtained all necessary information as to risks, contingencies and other circumstances which may influence or affect the Work;
- (2) Contractor accepts total responsibility for having foreseen all difficulties and costs and expenses of successfully completing the Work; and
- (3) No increase in the Contract Price, or extension of the schedule based in whole or in part upon any discrepancy between the actual conditions encountered by Contractor and those which Contractor anticipated, or any unforeseen difficulties or costs generally, shall be considered by the Owner or effected.

45.5 The Contractor acknowledges that all engineering data and information and data and information relating to hydrological, geo-technical and sub-surface at the Site made available to the Contractor by the Owner in the Specifications, information made available to bidders during the bid process, generally or otherwise, directly and indirectly, are all solely for the convenience of the Contractor. The verification and interpretation of the same shall be at the sole risk and responsibility of Contractor.

Contractor agrees that the Owner shall have no liability for the adequacy, correctness, accuracy or completeness of such data and information. The Owner makes no representation or warranty, express or implied, as to the adequacy, accuracy, correctness or completeness of any such data or information.



Contractor further agrees that it shall protect, indemnify and hold Owner harmless from and against any and all Losses arising directly or indirectly from or incurred by reason of the use of any such data and information by any Person to whom Contractor has supplied such data and information or any portion thereof including the Contractor himself, his Subcontractors, and their respective employees, agents, personnel and consultants.

Furthermore, Contractor hereby waives any claims it may otherwise have against any Person that has prepared, compiled, provided or prepared any such data and information arising due to any reason whatsoever, including without limitation, from the use thereof by Contractor or by other Persons to whom Contractor has supplied such data and information.

Specifically and without limitation, Contractor agrees and warrants that it shall independently and fully verify, check and establish the adequacy, correctness, accuracy and completeness of all data and information which it may require for any purposes related directly or indirectly to the Contract, its obligations hereunder or for any other reasons, at its sole risk and cost.

46.0

Applicable Permits

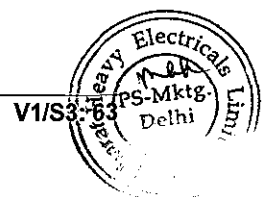
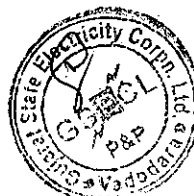
The Owner and the Contractor shall each be responsible for obtaining the Owner Permits and the Contractor Permits respectively. If the Contractor at any time becomes aware, whether as a result of notice from Owner or otherwise, of any Applicable Permit not obtained by the Contractor, the Contractor shall promptly give notice thereof to Owner and the Contractor shall be responsible for obtaining such Applicable Permit.

The Contractor shall be responsible for ensuring compliance with the terms and conditions of all Applicable Permits, whether obtained by the Owner or the Contractor.

The Contractor shall indemnify and hold harmless to the Owner and all Owner indemnified parties from and against any damages arising from and out of the securing of, or failure to secure, the Contractor Permits or failure to maintain the Owner Permits.

With respect to the Owner Permits, the Contractor shall provide support to Owner in obtaining all Owner Permits. Such Contractor support shall include:

- i. Attendance at meetings with Owner and third parties designated by Owner;
- ii. Preparation of permit applications or, as applicable, application to transfer permits to the Owner;
- iii. Assistance in preparation of responses to inquiries by governmental instrumentalities / agencies;
- iv. Assistance in presentations at hearing of governmental instrumentalities / agencies;
- v. Provision of all available information and documents required by Owner in connection with obtaining any Owner Permits; and



- vi. Such other services as Owner may request from time to time required for Owner permits.

47.0 **Law and Language**

The Contract and the respective rights, privileges, duties and obligations of the Owner and the Contractor hereunder shall be governed by the laws of the Republic of India.

48.0 **Stamp Duty**

Costs of stamp duty and other similar charges imposed by law on the Contract or any part thereof shall be borne by the Contractor.

49.0 **TERMINATION BY THE CONTRACTOR.**

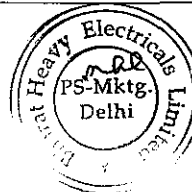
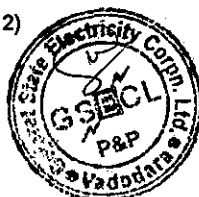
49.1 Upon the occurrence of any one or more of the following events, the Contractor may issue a notice of default to the Owner (the "Contractor's Preliminary Notice"):

- (a) If the Owner has failed to pay the Contractor any sum due to the Contractor under the Contract within sixty (60) days after the expiry of time agreed for payment of the said sum.
- (b) In case of prolonged suspension imposed by the Owner for a continuous period of 120 days that affects the whole of Works.
- (c) In case of prolonged suspension imposed by the Contractor under Clause 40.3 for a continuous period of 90 days that affects the whole of Works.
- (d) If the Owner is adjudged bankrupt or insolvent; or if the Owner makes a general assignment for the benefit of its creditors, or a trustee or a receiver is appointed for all or a substantial part of the Owner's assets, or if the Owner files a petition for reorganization under bankruptcy or other Applicable Laws.

if the Owner has not remedied or cured the default specified in the notice within 30 days of receipt of notice, then the Contractor shall have the right to terminate the Contract forthwith by issue of a notice of termination to the Owner.

Upon such termination the contractor shall be paid as per Clause no.24.2(a) & (b) i.e. Upon termination of the Agreement pursuant to Contractor's right to terminate, the Contractor shall be entitled to be paid :

- (a) all actual documented costs incurred by Contractor, as audited and accepted by an independent certified public accounting firm of national reputation selected by Owner and acceptable to Contractor, incurred or that could not be avoided in connection with performance by Contractor of Works as of the date of the Termination which were not previously paid for by



Owner, and

(b) all actual documented costs incurred by Contractor, if such cost is part of the Contract Price, in connection with the item procured / facilities executed procured by Contractor in connection with the services for which Contractor has not been paid, provided that such items are delivered to Owner at the Project Site together with all documents necessary to transfer title thereto to Owner (the 'Termination Payment'). As a condition precedent to receiving the Termination Payment, Contractor shall execute and deliver all such papers and take all such steps, including the legal assignment of Contractor's contractual rights, as Owner may require for the purpose of fully vesting in Owner all rights, title and interests of Contractor in and to all subcontracts, purchase orders, warranties, guarantees and other agreements.

(c) All claims by such contractors and Subcontractors to be due and owing for Services and other work performed prior to such date shall constitute debts between Contractor and Subcontractors, and Owner shall in no way be liable for such sums. Contractor shall include in all agreements and contracts entered into with contractors and Subcontractors a provision providing for the foregoing.

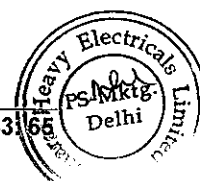
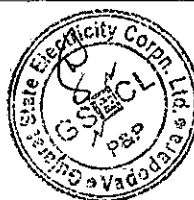
The Contractor shall send a copy of the Contractor's Preliminary Notice to the Lenders and notwithstanding anything contained in this Clause or in any other Clause of the General Conditions of Contract or elsewhere, the Contractor's right to terminate the Contract shall be subject to the right of the Lenders to step-in and remedy the default or substitute the Owner; provided that the Lenders must exercise their right to remedy the default and/or substitute the Owner within a period of thirty (30) days from the date of receipt of the Contractor's Preliminary Notice, failing which the Contractor shall have the right to terminate the Contract upon the expiry of the said 30 days' period."

50.0 DEEMED COMPLETION

In case the Performance Guarantee Tests cannot be completed within 90 days of Trial Operation for reasons not attributable to Contractor, the Performance Guarantee Tests shall be deemed to be completed successfully and the unit shall be deemed to be Taken Over and payment linked to this activity shall be released to Contractor by Owner. Contractor shall conduct the Performance Guarantee Tests to establish that performance guarantees are met for the unit, using applicable correction curves. Contractor shall be allowed to demobilize its resources on deemed completion of Performance Guarantee Tests and remobilize at the expense of the Owner for carrying out the Performance Guarantee Tests at a later date. In any case, the Performance Guarantee Tests for the unit shall be conducted within 6 months of the Trial Operation of the unit

51.0 DEEMED COMMISSIONING

In case the Initial Operation cannot be completed within 30 days from Scheduled date for reasons not attributable to the Contractor, the Initial Operation shall deemed to be completed and payment linked to successful completion of Reliability Run shall be released to the Contractor by Owner



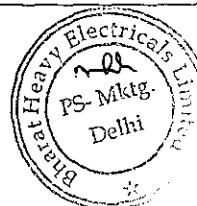
CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	PROJECT MANAGEMENT SERVICES
2.00.00	SITE SERVICES



(DEVELOPMENT CONSULTANTS
(K9213R-EPC-SPC-001-Vol-IIA-Sec-5)

078



VOLUME : IIA

SECTION-V

PROJECT MANAGEMENT AND SITE SERVICES

1.00.00 PROJECT MANAGEMENT SERVICES

1.01.00 Responsibility

The Bidder shall identify a separate and independent project management team headed by a Project Manager for the execution of this project. Responsibilities of this project Management team shall cover the areas listed below :

- a) Planning and Monitoring
- b) Engineering Management
- c) Contracts Management
- d) Quality Assurance, Inspection & Expediting
- e) Construction Management
- f) Spares Management
- g) Erection & Commissioning Management

Detailed responsibilities in the above areas are discussed below :

1.02.00 Organisation

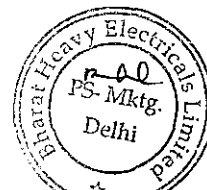
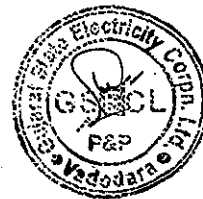
1.02.01 Headquarters

The headquarters of the project management team shall be headed by a senior level executive designated as the Project Manager who shall be responsible to Owner for the execution of the project. He should have adequate financial power and authority to give decision.

Separately, designated leaders shall be identified for each of the areas mentioned under 1.01.00, who, in turn, will report to the Project Manager for all matters relative to this contract.

1.02.02 Central Co-ordination Cell

The central coordination cell shall have sufficient technical personnel to coordinate technical matters and to quickly resolve day to day queries or references made by Owner and his Consultants without having the need to refer to his headquarters each time.



1.02.03 Site Organisation

The site should have a competent construction manager for all site operations with adequate financial power and sufficient level of authority to take site decisions. The organisation chart for site should indicate the various levels of experts to be posted for supervision in the various fields in civil construction, erection, commissioning etc.

1.02.04 Organisation Chart

The Bidder shall furnish a detailed organisation chart for the project management team, clearly identifying the key personnel in each of the areas mentioned at 1.01.00 above. The expected number of executives at different levels shall also be indicated, separately for headquarters, central coordination cell and site organisation.

1.03.00 Implementation Schedule

The schedule for the completion of the Project would be as follows :

Period in Months from Zero date (Taken
as the date of issue of Notice to Proceed)

a)	Boiler Hydro-test	By Bidder
b)	Boiler light up	By Bidder
c)	Unit synchronisation	45
d)	Commercial operation	48

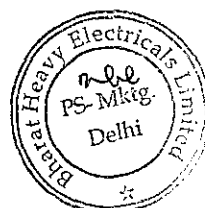
To achieve these targets, the Contractor shall furnish to the Owner, various schedules as defined below:

1.03.01 Engineering Schedules

These schedules shall cover various design submissions indicating different engineering activities to be performed. Such schedules shall be furnished by the Bidder for each and every plant/systems/ equipment item covered in the scope of this specification.

1.03.02 Manufacturing Schedule

The Contractor shall submit to the Engineer his manufacturing and delivery schedules for all equipment within thirty (30) days from the date of issue of the Letter of Award (LOA). Such schedules shall be in line with the detailed network for all phases of the work of the Contractor. Such schedules shall be reviewed, updated and submitted to the Engineer, once in every two months thereafter, by the Contractor. Schedules shall also include the materials and equipment purchased from outside suppliers.



1.03.03 Erection Schedules

In order to achieve the overall completion schedule, the Contractor shall provide the Owner all the information covering erection sequence, testing and commissioning activities. These schedules may be based on the recommended erection procedures and will be subject to discussions/agreements with the Owner subsequent to the award of contract.

1.03.04 The successful Bidder shall have to provide all the above schedules (i.e. 1.03.01, 1.03.02 & 1.03.03) in a tabular form in addition to that in the form of L2 & L3 networks and these shall necessarily include information not limited to the earliest and latest dates for various activities/submissions and also any related constraints. However, the Bidder shall include in his proposal a Level-1 (L-1) network showing the major activities and various milestones to achieve the above mentioned completion schedule.

1.03.05 The Contractor shall provide the Owner the original disc/software for all such schedules alongwith requisite no. of copies (as required by the Owner) within an agreed time schedule. This time schedule will be agreed between Owner/Bidder at the time of award. The Contractor's project management software shall be compatible with that of the Owner and the input data shall be furnished to the Owner in a manner compatible with Owner's project management software, Primavera.

1.04.00 Detailed Responsibilities

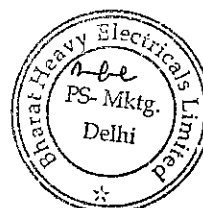
1.04.01 Planning & Monitoring

a) Planning

The Bidder shall prepare a Master Network Schedule in the form of PERT network.

The network shall be prepared on a Work Breakdown Structure for the project which sub-divides the project into a set of manageable systems/sub-systems. The master network will identify milestones of key events for each system/package in the areas of engineering, procurement, manufacture and despatch and erection and commissioning. The master network shall represent the Level-I plan and will form the basis for development of detailed second and third tier execution plans. The master network shall conform to the overall schedule prescribed by Owner.

The master network should be submitted along with the bid which would be mutually discussed and finalised before the Award of Contract. This master network would clearly indicate the responsibility of the Bidder and project management team. This master network would form a part of the contract. The master network shall also identify a complete list of inputs to be furnished by the Owner which may be required for proper interfacing and tie-up. Scheduled dates for providing such inputs shall also be indicated, which will be mutually discussed and finalised.



b) Monitoring & Progress Reporting

The progress reports would be emanated every month, one from the head office of the Contractor and another from the site office. The progress report emanating from the head office should necessarily include the following sections:

- i) Report on key milestones.
- ii) Management summary indicating critical areas with details of actions initiated and effect of any on the project.
- iii) Action needing attention of the Owner/Consultant.
- iv) Detailed packagewise status of engineering submissions, quality plan submissions and approval, procurement manufacture and despatch.

The monthly report generated from the site office should necessarily include:

- i) Report on key milestones.
- ii) Management summary indicating critical areas with details of actions initiated and effect if any on the project.
- iii) Action needing attention of the Owner/Consultant.
- iv) This report would also cover the areas pertaining to the receipt of the equipment at the port, port clearance, transport, receipt at site, erection and commissioning.

In addition to the above, as the project execution progresses, the Contractor shall also be responsible for generating more frequent reports in the form of fax/e-mail information on progress in critical areas so that actions can be expedited. The exact format of the progress report shall be finalised after award of Contract.

1.04.02 Engineering Management

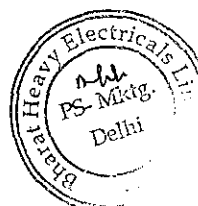
Based on the master network for the project (L-1) the Contractor will prepare an exhaustive list of engineering activities for the equipment/systems covered in his scope and a detailed programme of accomplishing the same within the time frame specified in the master network. This schedule will form the Level-2 (L-2) network for engineering activities.

Based on (L-2) network, the Bidder shall further develop the Level-3 (L-3) network for engineering activities which will indicate schedule for data availability, drawing release date and document submission dates.

(DEVELOPMENT CONSULTANTS
(K9213R-EPC-SPC-001-Vol-IIA-Sec-5)

V IIA/S-5 : 4

082



Detailed (L-2) and (L-3) networks would be submitted sequentially by the Contractor within two months from the date of issue of Letter of Award and finalised within one (1) month thereafter.

All such networks shall be provided in MS PROJECT software as well as in other format / software suitable to Owner.

The engineering management team should also co-ordinate all interface engineering activity between the Contractor and the equipment sub-vendors so as to ensure the correctness and completeness of related engineering documentation before the same is submitted to the Owner.

1.04.03 Contracts Management

Based on the master network, the Contractor shall submit L-2 programmes of manufacture and despatch. In addition, the master network shall also include periods considered for site activities viz. erection, commissioning etc. These L-2 programmes would be submitted in 2 months time from the date of award of contract and finalised within one (1) month thereafter. The Contractor will also submit site mobilisation plan. This programme would be submitted at the time of finalisation of award of contract and agreed immediately thereafter so that immediate development of the various activities at site could take place.

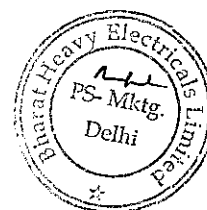
The Contractor should also submit L-3 programmes for the manufacturing, despatch of the various items. These networks shall also show the customer hold points (CHP) which have to be cleared by Owner or their authorised representative(s) before further manufacture can take place. These L-3 programmes for the manufacture and despatch would clearly identify responsibilities of the Contractor, sub-Contractor and Owner. These networks shall be submitted within one (1) month of the date of finalisation of the various sub-contracts by the Contractor.

In case all the manufacture is being done by the Contractor then the L-2 programmes would be themselves amplified to cover details of the manufacture, inspection, clearance by Owner and despatch.

The Contractor shall also submit the programme for procurement of boughtout items, detailed shipping schedule and cash flow statement for Owner's approval.

1.04.04 Quality Assurance, Inspection and Expediting

The Contractor shall submit the list of manufacturers/sub-vendors from whom the equipment are expected to be procured and the quality assurance plans thereof for the manufacture shall be approved by the QA group of Owner before the manufacture is commenced. The list of major suppliers would be submitted along with the bid and this shall be mutually discussed and approval will be given by the Owner during contract negotiation meeting prior to placement of Letter of Award. This approved list will be binding to the bidder. In the said list, Owner reserves the right to include reputed/reliable vendors of his own choice. Regarding the various other sub-vendors, the list would be submitted within six (6) months of the award of the contract that shall be scrutinized by the Owner to accord approval. In such list Owner



reserves the right to include vendors of his own choice. No further vendor approval will be given after six (6) months. On the quality plans, the customer hold points will also be identified based on which Owner would give clearance for the manufacture to proceed further.

Quality assurance/Inspection group of Owner or its representative would issue a material despatch clearance certificate (MDCC) after the inspection clearance which will enable the Contractor to despatch the equipment and claim the payment. In the despatch programme, the Contractor shall indicate a schedule of estimated programme, tonnages specifically identifying various oversize dimensioned consignments (ODC). Further the Contractor will also be required to ensure at all stages of shipment that packing of all shipments despatched are suitable for ocean freight to India, handling at the port of entry, inland transportation and preservation at site upto erection. All despatch details & item lists shall be made available to both Owner & site immediately after shipping.

The Contractor shall also expedite all despatches from their own works/works of their sub-vendors, so as to match with the various activities mentioned at 1.04.03 above.

1.04.05 Construction Management

Based on the L-1 Master Network Programme, within two (2) months of the issue of Letter of Award, the Contractor shall submit a programme of construction/erection/commissioning, either in continuation with the manufacture and despatch or separately for the implementation. These programmes would be amplified showing when the civil drawings shall be released by him and construction of civil works shall be completed by him to facilitate start of erection and subsequent activities and shall form the basis for site execution and detailed monitoring. The three monthly rolling programme with the first month's programme being tentative based on the site conditions would be prepared based on these L-3 programmes. The Contractor shall also be involved along with the Owner to tie up detailed resource mobilisation plan over the period of time of the contract matching with the performance targets.

The L-3 programme would be jointly finalised by the site in charge of the Contractor with the Owner's project coordinator as well as the site planning representative. The erection programme will also identify the sequential erectable tonnages that are required for various equipment which should be taken care of in the despatch programmes.

Erection and commissioning of the equipment shall also be done under the supervision of experts from the respective equipment/ system supplier.

1.04.06 Spares Management

Alongwith the proposal for the plant and equipment, the Contractor shall also submit proposals/schedule for the following:

- a) Mandatory spares
- b) Recommended spares



While the award for mandatory spares will be finalised at the time of the award of contract, recommended spares will be finalised thereafter.

1.05.00 Project Progress Review Meetings

Keeping in mind the overall responsibility of the Contractor it is intended that periodic progress reviews on the entire activities of execution in respect of Wanakbori Thermal Power Plant (Unit-8) will be held initially atleast once in two (2) months at Vadodara/site or in the country (India) depending on the circumstances and mutual agreement. During peak period it may be held once in a month. These meetings will be attended by reasonably higher officials of the Contractor and their leading sub- contractors and will be used as a forum for discussing all areas where progress needs to be speeded up. Actions will be placed on the concerned agencies and decisions will be taken to expedite/speed up the progress. Minutes of such meetings will be issued reflecting the major discussions and decisions taken and circulated to all concerned for reference and action. The Contractor shall be further responsible for ensuring that suitable steps are taken to meet various targets decided upon such meetings.

In addition to the above, and to streamline the construction and erection at site, a suitable frequency and forum of periodic meetings between the Contractor and the Owner will be decided upon as part of erection coordination procedure. Site co-ordination meeting may be held on weekly basis.

1.06.00 Owner's Consultant

The Owner would appoint a consultant to assist him in some of the areas mentioned at 1.01.00 above. The details of interaction and procedures for coordination between Owner/Owner's Consultant & Contractor/ Contractor's project management team shall be finalised during contract negotiations.

1.07.00 Commissioning Management

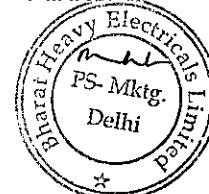
1.07.01 For commissioning of the various equipment/system covered under the scope of contract, Owner will form an organisation structure which may consist of the following committees. The Contractor shall nominate his representative on one or more of the committee as decided by the Owner:

- a) Steering Committee
- b) Commissioning Panel.
- c) Working Parties
- d) Testing Teams.

1.07.02 Commissioning documents shall be prepared by the Contractor in following manner and submitted for Owner's approval :

- a) Field Quality Plan

This document shall be prepared for the various equipment/ systems under commissioning and shall have the following objectives to fulfill and shall be submitted for Owner's approval at least six (6) months before their actual commissioning :



- i) Establish design data against which Plant Performance will be compared.
 - ii) Set-out the testing objectives and proposals.
 - iii) Define the documentation required.
- b) Testing/Commissioning Schedule
- These shall be prepared for the various equipment/systems under consideration and shall contain sections like detailed testing method, programme, safety, individual responsibility and results.
- c) Standard Check Lists
- Standard check lists are intended for use at the completion of erection to ensure correct erection, testing and to a limited extent operation for repetitive items.

1.07.03 Test Reports

After the completion of commissioning activity of equipment/ systems, the Contractor shall prepare the test reports which shall include all the relevant information related to various commissioning checks, tests carried out, any deviations/commissions noticed with respect to the intended design requirements, sequence of various commissioning activities as actually adopted vis-a-vis as recommended in the procedures, programme schedules achieved and any other such information as required. These test reports shall be submitted in requisite number of copies to the Owner and this should be duly signed jointly by the Owner/Consultant and the Contractor/Equipment supplier, who are involved during the commissioning activities.

2.00.00 SITE SERVICES

These services shall be rendered by the Bidder as part of the overall project management service. The services shall broadly include but not be limited to the following :

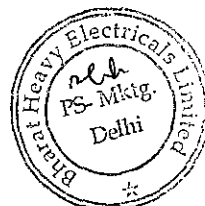
- 2.01.00 Arranging material despatch from the shop by rail/road and/or sea as applicable.
- 2.02.00 Monitoring movement of materials & follow-up as necessary with Railways, road transport, port clearance etc. from the time of despatch F.O.R. works/ F.O.B. port of shipment by Contractor till receipt of the same at site.
- 2.03.00 Unloading of materials at Railway Station/Railway Siding inside project area/ Road Transportation, transportation to site store, assessment of lost/ damaged items in transit and arranging insurance claims and replacement of lost/damaged items. The Contractor shall submit to the Engineer a report detailing all the receipts during the week as well as storing, preservation of material at site.

(DEVELOPMENT CONSULTANTS
(K9213R-EPC-SPC-001-Vol-IIA-Sec-5)

V IIA/S-5 : 8



086



- 2.04.00 Issuing materials from site store/open yard from time to time for erection as per the construction programme. The Contractor shall be the custodian of all the materials issued till the plant is officially taken over by the Owner after complete erection and successful trial run & commissioning.
- 2.05.00 Transportation of materials to their respective places of erection and erection of the complete plant & equipment as supplied under this specification.
- 2.06.00 Trial run and commissioning of individual equipment/sub-systems and the plant as a whole to the satisfaction of the Owner, including supply of temporary equipment & services for chemical cleaning, steam blowing as well as performance guarantee tests.

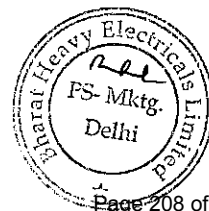
Apart from Boiler, proper chemical cleaning shall be carried out in following pipe lines/equipment before commissioning

- a) Deaerator
- b) Boiler feed suction, recirculation leak-off lines
- c) Boiler Feed discharge line by passing heaters
- d) Attenuation lines
- e) Condensate suction & discharge piping upto de-aerator by passing the feed water heaters.
- f) Fuel oil lines.

Provision for preservation of individual equipment after trial run and commissioning e.g. Nitrogen blanketing etc. as necessary shall also be in the scope of the Bidder.

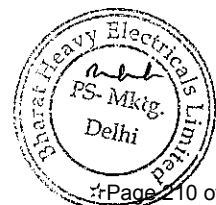
Safe disposal of effluent after chemical cleaning shall be done by the contractor.

- 2.07.00 Supply and application of the final paints and first fill lubricants on all the equipment to be erected under this specification. Supply of LDO, chemicals, lub oils upto COD.
- 2.08.00 For the purpose of erection and commissioning the Contractor's scope of work shall include but not be limited to the following :
- 2.08.01 Deployment of all skilled and unskilled manpower required for erection, supervision of erection, watch & ward, commissioning and other services to be rendered under this specification.
- 2.08.02 Deployment of all erection tools & tackle, construction machinery, transportation vehicles and all other implements in adequate number and size, appropriate for the erection work to be handled under the scope of this specification.



- The Contractor shall also submit to the Owner for approval a list of construction equipment, erection tools, tackle etc. prior to commencement of site activities. These tools & tackle shall not be removed from site without written permission of the Owner.

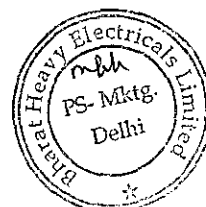
- 2.10.00 **General Guidelines for Field Activities**
- 2.10.01 The Contractor shall execute the works in a professional manner so as to achieve the target schedule without any sacrifice on quality and maintaining highest standards of safety and cleanliness.
- 2.10.02 The Contractor shall co-operate with the Owner and other Contractors working in site and arrange to perform his work in a manner so as to minimise interference with other Contractors' works. The Owner's engineer shall be notified promptly of any defect in other Contractor's works that could affect the Contractor's work. If rescheduling of Contractor's work is requested by the Owner's engineer in the interest of overall site activities, the same shall be complied with by the Contractor. In all cases of controversy, the decision of the Owner shall be final and binding on the Contractor without any commercial implication.
- 2.10.03 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 Work. In addition to the above weekly meeting, 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.
- 2.10.04 Time is the essence of the Contract and the Contractor shall be responsible for performance of his Work 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 of 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 action 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.
- 2.10.05 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 co-ordination work between various Contractors as set out earlier.
- 2.10.06 The works under execution shall be open to inspection & supervision by the Owner's engineer at all times. The Contractor shall give reasonable notice to the Owner before covering up or otherwise placing beyond the reach of inspection any work in order that same may be verified, if so desired by the Owner.
- 2.10.07 Every effort shall be made to maintain the highest quality of workmanship by stringent supervision and inspection at every stage of execution. Manufacturer's instruction manual and guidelines on sequence of erection and precautions shall be strictly followed. Should any error or ambiguity be discovered in such documents, the same shall be brought to the notice of the Owner's engineer. Manufacturer's interpretation in such cases shall be binding on the Contractor.



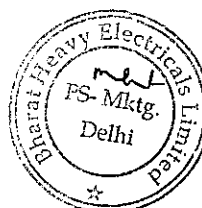
- 2.10.08 The Contractor shall comply with all the rules and regulations of the local authorities, all statutory laws including Minimum Wages, Workmen Compensation etc. All registration and statutory inspection fees, if any, in respect of the work executed by the Contractor shall be to his account.
- 2.10.09 All the works such as cleaning, checking, leveling, blue matching, aligning, assembling, temporary erection for alignment, opening, dismantling of certain equipments for checking and cleaning, surface preparation, edge preparation, fabrication of tubes and pipes as per general engineering practice at site, cutting grinding, straightening, chamfering, filling, chipping, drilling, reaming, scrapping, shaping, fitting-up bolting/welding, etc., as may be applicable in such erection and are necessary to complete the work satisfactorily, are to be treated as incidental and the same shall be carried out by the Contractor as part of the work.
- 2.10.10 In case of any class of work for which there is no such specification as laid down in the contract such as, blue matching, welding of stainless steel parts, etc., the work shall be carried out in accordance with the instructions and requirements of the Engineer.
- 2.10.11 It may sometimes be necessary to remove some of the erected structural members to facilitate erection of bigger/pre-assembled equipment. In such cases, the removal and re-erection of such members, which are essential, and if so agreed by the Engineer, will have to be done by the Contractor.
- 2.10.12 Attachment welding of necessary instrumentation tapping points, thermocouple pads, root valves, condensing vessels, flow nozzles and control valves etc., both for regular measurement and performance testing to be provided on equipment, its auxiliaries or pipelines covered within the scope of this tender, will also be the responsibility of the Contractor and the same will be done as per the instructions of Engineer. The erection and welding of all above items will be the Contractor's responsibility, even if :
- a) Product groups under which these items are re-leased are not covered in the scope of this tender.
 - b) Items are supplied by an agency other than the Contractor.
- 2.10.13 Preservation of all materials/equipment under custody of the Contractor during storage, pre-assembly & erection, commissioning etc., shall be the responsibility of the Contractor. All necessary preservatives and consumables like paints, etc., shall be arranged by the Contractor. Necessary touch up painting, periodic application of preservatives/paints on pressure parts/other equipment even after erection until completion of work shall be carried out by the Contractor. The Contractor shall fabricate piping, install lub oil systems and carry out the acid cleaning of fabricated piping. The Contractor shall also service the lub. oil system, carryout the hydraulic test of oil coolers, etc.
- 2.10.14 It is responsibility of the Contractor to do the alignment etc. if necessary, repeatedly to satisfy Engineer, with all the necessary tools & tackles, manpower, etc. The alignment will be complete only when jointly certified so, by the Contractor's Engineer & Owner. Also the Contractor should ensure that the alignment is not disturbed afterwards.



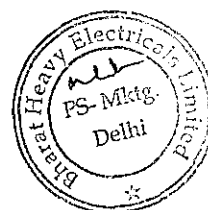
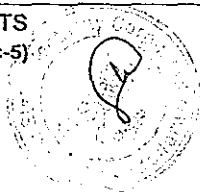
090



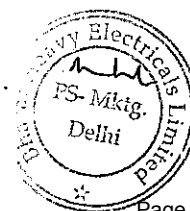
- 2.10.15 Additional platforms for approaching different equipment as per site requirement, which may not be indicated in drawings, shall be fabricated and erected by the Contractor. The materials required for these works shall be supplied by the Contractor and he will have to fabricate them to suit the requirement.
- 2.10.16 Equipment and material which are wrongly installed shall be removed and reinstalled to comply with the design requirement at the Contractor's expense, to the satisfaction of the Owner/ Consultant.
- 2.10.17 Before erection of any equipment on a foundation, the Contractor shall check and undertake if necessary rectification of foundation bolts, reaming of holes, drilling of dowels, matching of bolts and nuts, making new dowel pin, etc.
- 2.10.18 Assistance for calibrating/testing the power cylinders, valves, gauges, instruments, etc., and setting of actuators coming under various groups shall be provided by Contractor.
- 2.10.19 It shall be the responsibility of the Contractor to provide ladders on columns for initial works till such time stairways are completed. For this, the ladder should not be welded on the column and should be prefabricated clamping type. No temporary welding on any structural member is permitted except under special circumstances with the approval of Owner.
- 2.10.20 Structural materials required for the supporting/operating platforms required for the valves at various levels for the same operation of valves will be arranged by the Contractor.
- 2.10.21 For civil, structural and architectural works, volume IIG/1 & IIG/2 may be referred. For Instrumentation and Electrical works Vol. IIE and Vol. IIF/1 & F/2 may be referred.
- 2.11.00 **Safety**
Safety and overall cleanliness of work site shall be given top priority.
- 2.11.01 The Contractor shall ensure the safety of all workmen, materials and equipment either belonging to him or to others working at site. He shall observe safety rules & codes applied by the Owner at site without exception.
- 2.11.02 The Contractor shall notify the Owner of his intention to bring to site any equipment or material which may create hazard. The Owner shall have the right to prescribe the conditions under which such equipment or material may be handled and the Contractor shall adhere to such instructions. The Owner may prohibit the use of any construction machinery, which according to him is unsafe. No claim for compensation due to such prohibition will be entertained by the Owner.
- 2.11.03 Storage of petroleum products & explosives for construction work shall be as per rules and regulation laid down in Petroleum Act, Explosive Act and Petroleum and Carbide of Calcium Manual. Approvals as necessary from Chief Inspector of Explosives or other statutory authorities shall be the responsibility of the Contractor.



- 2.11.04 The Contractor shall be responsible for safe storage of his and his sub-contractor's radioactive sources.
- 2.11.05 All requisite tests & inspection of handling equipment, lifting tools & tackle shall be periodically done by the Contractor. Defective equipment shall be removed from service. Any equipment shall not be loaded in excess of its recommended safe working load.
- 2.11.06 All combustible waste and rubbish shall be collected and removed from the worksite at least once each day. Use of undercoated canvas paper, corrugated paper, fabricated carton, plastic or other flammable materials shall be restricted to the minimum and promptly removed.
- 2.11.07 The Contractor shall provide adequate number of fire protection equipment of the required types for his stores, office, temporary structures, labour colony etc. Personnel trained for fire-fighting shall be made available by the Contractor at site during the entire period of the Contract.
- 2.11.08 All electrical appliances used in the work shall be in good working condition and shall be properly earthed. No maintenance work shall be carried out on live equipment. The Contractor shall maintain adequate number of qualified electricians to maintain his temporary electrical installation.
- 2.11.09 All workmen of the Contractor working in construction site shall wear safety helmets, safety boots and safety belts. The Contractor shall take appropriate insurance cover against accidents for his workmen as well as third party.
- 2.11.10 All the worksites shall be provided with adequate lighting facilities e.g. flood lighting, hand lamps, area lighting etc. by the Contractor for proper working environment during night times.
- 2.11.11 All safety precautions shall be taken for welding and cutting operations as per IS-818.
- 2.11.12 All safety precautions shall be taken for foundation and other excavation marks as per IS-3764.
- 2.12.00 **Taking Delivery & Storage**
- 2.12.01 The Contractor shall arrange issue of all equipment and materials to be erected under the contract from the stores/open yard at site by signing on standard indent forms. After completion of work, detailed auditing of the materials so issued shall be submitted to the Owner.
- 2.12.02 The Contractor shall arrange for proper and safe storage of materials till the same are taken over by the Owner as per terms of the contract. Manufacturer's instructions for preservation shall be strictly followed.
- 2.12.03 All empty containers, packing materials, gunny bags, transport frames and also surplus and unused materials reconciliation prior to completion of contract shall be the property of the Owner and returned to the Owner by the Contractor.



- 2.13.00 **Site Welding & Heat Treatment**
- 2.13.01 Welding shall be done in accordance with IS-813, IS-816, IS-9595 & other relevant IS/International standards and as per instructions of Contractor. Only those welders, who are qualified as per IS-817 for ordinary welds and as per IBR/ASME Section-IX for high pressure welds, shall be employed in the job.
- 2.13.02 All welders shall be tested and approved by Engineer before they are actually engaged on the work even though they may possess the requisite certificates. The Owner reserves the right to reject any welder without assigning any reason. The welder identification code as approved by the Engineer shall be stamped by the welder on each joint done by them. The Contractor will be responsible for the periodic renewal, re-testing of the welders as demanded by Owner.
- 2.13.03 The Engineer is entitled to stop Contractor's any welder from his work if his work is unsatisfactory for any technical reason or there is a high percentage of the rejection of joints welded by him, which in the opinion of Engineer will adversely affect the quality of welding even though the welder has earlier passed the tests. The welders having passed the tests do not relieve the Contractor from his contractual obligations, to check the performance of the welders.
- 2.13.04 All charges for testing of welders including destructive and non-destructive tests if conducted by Owner or by the inspection authority at site shall have to be borne by the Contractor. The necessary test materials and consumables will have to be arranged by the Contractor and all testing facility made available, as required.
- 2.13.05 All welded joints shall be subject to acceptance by Engineer. Inspection of welds shall be in accordance with IS-822 or equivalent code.
- 2.13.06 Preheating/post heating and stress relieving after welding are part of fabrication and erection work and shall be performed by the Contractor in accordance with the instruction of Engineer. Contractor shall arrange to supply heating equipment with automatic recording devices. Also the Contractor shall have to arrange for the labour, heating elements, thermocouples, compensating cables, insulation materials like mineral wools, asbestos cloth, ceramic beads, asbestos rope, etc. required for the heat-treatment and stress relieving works. During pre-heat/stress relieving operations, the temperature shall be measured at one or more points as required by attaching thermocouples and recorded on a continuous printing type recorder. All the record graphs for the heat treatment works carried out shall be got signed by the Engineer prior to the commencement of each cycle and handed over to Engineer on completion. The graphs will be the property of Owner. The Contractor has to provide thermo-chalks temperature recorders, thermocouple attachments, units, graph sheets, etc. required for the job and maintain them in good condition.
- 2.13.07 All electrodes shall be baked and dried in the electric/electrode drying oven to the required temperature and for the period specified by the Engineer before they are used in erection work. The electrodes used shall be as per IS-814, IS-815, IS-1442, IS-7280 and other codes as applicable, and shall be of



approved reputed manufacture. The electrodes shall meet the requirement of the pipe material. No electrode manufactured more than 12 months ago and the type covered under certificate issued after conducting tests more than 6 months ago shall be used. All electrodes shall be preserved at works and at site as per manufacturer's recommendations.

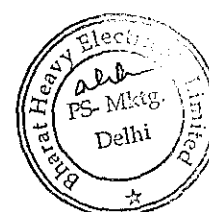
- 2.13.08 Oxy-acetylene flame or Exothermic chemical heating for stress relieving is not permitted. Heating shall be by means, of electric induction coil or electric resistance coil.
- 2.13.09 It may become necessary to adopt inter layer radiography/MPT/UT depending upon the site/technical requirement necessitating interruptions in continuation of the work and making necessary arrangement for carrying out the above work.
- 2.13.10 Gas tungsten arc welding process (TIG) shall be adopted for all root pass welds except for structural works until 4.75 mm thickness is deposited. Subsequent welding after root pass can be carried out by manual metal arc welding with coated electrodes. For pipes of thickness less than 6 mm the entire welding has to be carried out by TIG welding.
- Fillet weld shall be made by shielded metal arc process as per applicable codes.
- However, the Engineer will have the option of changing the method of welding as per site requirement. The method adopted for manual arc welding shall be weaving technique and the width of weaving shall not exceed 1.5 times of the dia. of the electrode.
- In case of deviation from welding process and electrodes, the Contractor shall take approval of the Owner prior to adoption of same.
- 2.13.11 The root pass for butt joints shall be such as to achieve full penetration with complete fusion of root edges.
- 2.13.12 Each pass shall be cleared and freed of slag before the next pass is deposited.
- 2.13.13 On completion of each run, craters, weld irregularities, slag etc. shall be removed by grinding or chipping.
- 2.13.14 Each layer of welding shall have an even and smooth appearance.
- 2.13.15 Welding sequence shall be adjusted in such a way that distortion due to welding shrinkage is minimised. Further any movement, shock or vibration during welding shall be avoided to prevent weld cracks.
- 2.13.16 Proper protection of welders and the work shall be taken during periods of rain. No welding shall be carried out when surfaced to be welded are wet from any cause.

(DEVELOPMENT CONSULTANTS
(K9213R-EPC-SPC-001-Vol-IIA-Sec-5)



V IIA/S-5 : 16

094

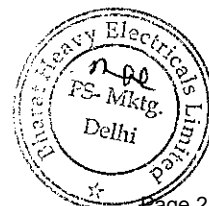


2.13.17 Following will be stages of inspection during welding :

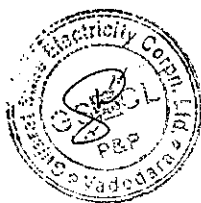
- a) Two pieces to be joined shall be individually checked for the weld edge preparation and profile dimensionally and to the template. Dye penetrant check shall be carried out on edge prepared surfaces at random. The percentage will depend upon on criticality as specified by Engineer.
- b) Joint fit up will be a stage of inspection. Misalignment after fit up may vary from 0.3 mm to 1.6 mm depending on outside diameter and thickness.
- c) All joints shall be offered for visual inspection after root run. Subsequent welding should be made only after the approval of root run.

2.13.18 All welded joints shall be painted with anti-corrosive paint immediately on completion of radiography and stress-relieving.

2.14.00 For further details on procedures of work at site on civil, architectural, electrical and instrumentation & control services, refer Volume : II-E, II-F & II-G of this specification.

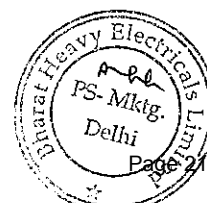


VOLUME : IIA
SECTION-VI
ENGINEERING SERVICES



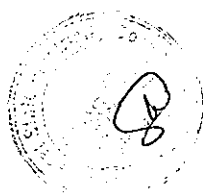
DEVELOPMENT CONSULTANTS
(K9213R-EPC-SPC-001-Vol-IIA-Sec-6&7)

096



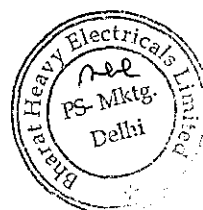
CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	GENERAL
2.00.00	DESIGN COORDINATION MEETING
3.00.00	CO-OPERATION WITH OTHER CONTRACTORS AND CONSULTING ENGINEERS
4.00.00	GUIDELINES FOR ENGINEERING SERVICES
5.00.00	OPERATING MANUALS AND MAINTENANCE INSTRUCTIONS
6.00.00	PLANT HANDBOOK
7.00.00	CONTRACT STAGE DOCUMENT SUBMISSION AND APPROVAL PROCEDURE
8.00.00	TENDER STAGE DOCUMENT SUBMISSION



DEVELOPMENT CONSULTANTS
(K9213R-EPC-SPC-001-Vol-IIA-Sec-6&7)

097



VOLUME : IIA

SECTION-VI

ENGINEERING SERVICES

1.00.00 GENERAL

1.01.00 As part of the overall project management activity, the Contractor shall be responsible for proper engineering and co-ordination of activities during various phases of execution of the contract. The Contractor shall identify a person, designated as Project Manager, with whom the Owner, the Consulting Engineer or the Review Consultant shall interact on matters related to engineering as well as execution of the contract. The Project Manager shall be the single-point contact person on behalf of the Contractor and shall be responsible for all engineering co-ordination. The Owner/Consultant/Review Consultant shall interact with the Project Manager only on all matters of co-ordination between the Owner and the Contractor or on matters involving the Contractor, his manufacturing units and sub-vendors. For the purpose of expediting the Owner or his representative may sometimes interact with the manufacturing units or sub-vendors of the contractors. However such interaction will not, under any circumstance, dilute the responsibility of the Contractor to provide a fully engineered and co-ordinated package under this contract.

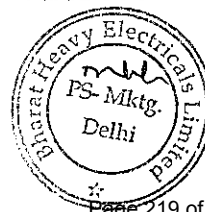
1.02.00 On finalization of the contract, a procedure for exchange of engineering information will be mutually agreed and finalized between the Owner and the Contractor.

2.00.00 DESIGN COORDINATION MEETING

The Contractor and his sub-vendors 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 execution of contract. The Contractor including his sub-vendors shall attend such meetings at their own cost at Owner's or Consultant's office in Kolkata or at mutually agreed venue as and when required and fully cooperate with such persons and agencies involved during those discussions.

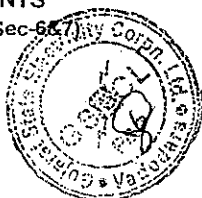
3.00.00 CO-OPERATION WITH OTHER CONTRACTORS AND CONSULTING ENGINEERS

The Contractor shall agree to cooperate 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 copies of all correspondences addressed by the Contractor to other Sub- contractors and Consulting Engineers in respect of such exchange of technical information.

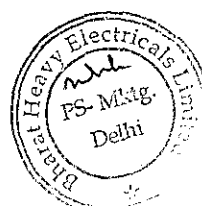


4.00.00 GUIDELINES FOR ENGINEERING SERVICES

- 4.01.00 Prior to commencement of the engineering work as part of design submissions, all aspects of design viz., criteria for selection and sizing of all equipment and systems, design margins etc. including that for structural steel and civil work shall be outlined and these shall form the basis for the detailed engineering work.
- 4.02.00 Engineering work shall be performed on modern and proven concepts and internationally accepted good engineering practices but fully compatible with the Indian environments. Owner shall have the right to review and approve the engineering work by themselves and/or through consultant and ask for any clarifications and changes/modifications to the work performed by Contractor.
- 4.03.00 At any stage during the performance of assignment, the Contractor may be required to make certain changes/modification/improvements in design/drawing/other documents which are applicable to 800 MW Unit, which in the opinion of the Owner could result in better improved design, layout, operability, plant availability, maintainability, reliability or economy of the plant and its systems/sub-systems in view of revised and more accurate information/data available at a later date(s) or feedback(s) received during execution / operation of similar units. Such changes / modifications/improvements required could be identified by Owner and/or consultant and mutually discussed. Owner requires the Bidder to incorporate such action in the subject assignment appropriately without any additional cost liability and time implication to the Owner and same shall be within the responsibilities and scope of the Contractor.
- 4.04.00 During the course of review of detailed engineering stages, it may be essential in the opinion of Owner to obtain certain classified data for review purposes only. In case Owner so desires, the Bidder shall submit such data to Owner.
- 4.05.00 During the course of review of detailed engineering, it may be essential in Owner's opinion to obtain data and information on similar equipment and plants engineered by the Bidder. In case Owner so desires the Bidder shall submit such data and information to the Owner.
- 4.06.00 It is not the intent to give details of every single task covered in the total engineering work to be carried out by Contractor, however, all engineering work required for the satisfactory completion of the plant/systems as specified shall be carried out by the Contractor. Broadly, the following are the minimum requirements in respect of scope of major items of work:
- 4.06.01 Preparation, updating and finalisation of scheme drawings, control and interlock diagrams, detailed and fully dimensioned layout drawings (plant layout and equipment layout detailed plan, elevation and cross-sectional drawings at different elevations / floor levels) covering all mechanical, electrical, C&I, civil and structural items, equipment, systems and facilities. Drawings and Schedules prepared by the Contractor from time to time, as detailed designs are developed, shall be submitted for Owner's / Consultant's approval before the work is taken up. Revisions, corrections, additions to drawings and schedules shall not be considered to change the scope of work.



099



- 4.06.02 Preparation of detailed technical specifications including data sheets, tender drawings and bill of material for all bought out items, as also finalisation of corresponding sub-contractors.
- 4.06.03 Review of sub-contractor's data, drawings, design calculations, schedules, bill of materials, instruction manuals etc. for all equipment, before forwarding them to Owner/Consultant for approval.
- 4.06.04 Preparation of civil construction drawings for all equipment showing foundation details and full details regarding equipment loads, floor openings; details of embedments etc. required for preparation of civil construction drawings and also as referred at relevant sections of Scope, Terminal Points & Exclusions. These documents shall be preceded by appropriate design calculations, static and dynamic analysis as necessary.
- 4.06.05 Preparation and finalisation of process piping and instrumentation diagrams and schematics, complete in all respects for all systems/packages of the power plant.
- 4.06.06 Preparation of consolidated schedules and bills of materials, including line numbers, tag numbers, source of supply, service conditions, specifications, materials, types and connections details, quantities for items of the plant including dampers, steam traps, strainers, instrumentations, ducting.
- 4.06.07 Sizing of all piping and equipment as per the stipulated design criteria; carrying out of flexibility analysis/dynamic analysis as necessary; hangers & support engineering.
- 4.06.08 Final revision of all documents including preparation and compilation of Instruction Manuals for installation, commissioning, operation and maintenance for all equipment and systems. Refer clause 5.00.00 for the specific requirement in this regard.
- 4.06.09 Certification and submission of final as-built drawings for all areas.
- 4.06.10 Preparation and compilation of all drawings, schedules and instructions which may be required at site, whether separately mentioned or not.
- 4.06.11 All erection and assembly drawings which may be required at site.
- 4.06.12 For all bought out item packages, the Contractor shall provide complete material / component list along with detail specification, drawings, component part no. etc. during detail engineering stage prior to final approval. Such approved drawing/document shall be made available at site in adequate number prior to commencement of work. Moreover, such document/drawing shall be provided in soft form (CD)
- 4.06.13 Preparation of necessary documentation, design calculations etc. required for submission to statutory authorities like IBR, Chief Electric Inspector etc.



5.00.00 OPERATING MANUALS AND MAINTENANCE INSTRUCTIONS

5.01.00 The Contractor shall provide at least six (6) months before the time of commissioning and before taking over of the plant and equipment, all necessary maintenance manuals and operating instructions. The instruction manual shall be submitted in the form of one (1) soft copy in CD and 15 hard copies.

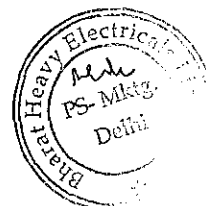
5.02.00 The information provided, which shall be contained in loose leaf stiff backed covers, shall include :

- a) A complete inventory of all main items of plant, with identification details.
- b) Service manuals for all plant and equipment giving full descriptions of the main items and auxiliary items such as power packs, hydraulic equipment, actuators, lubricating pumps, etc.
- c) A separate electrical manual covering items such as switchgear, cabling, instrumentation, controls, cabling layouts and wiring diagrams.
- d) A schedule of recommendations for routine maintenance of all electrical and mechanical equipment, recommended inspection point, information on detection, cause and rectifications of troubles & faults.
- e) A lubrication schedule with all necessary drawings diagrams to identify the lubrication points.
- f) Manufacturer's literature.

5.03.00 The instruction manual shall be subject to the approval of Owner.

6.00.00 PLANT HANDBOOK

The Contractor shall submit to the Engineer, a preliminary plant handbook preferably in A-4 size sheets which shall contain the design and performance data of various plant, equipment and systems covering the complete project including single line flow diagrams, within twenty four (24) months from the date of his acceptance of the letter of award. The final plant handbook complete in all respects shall be submitted by the Contractor six (6) months before start-up and commissioning activities. The plant handbook shall be submitted in the form of two (2) soft copy in CD (one to Owner and one to Consultant) and twenty five (25) hard copies in decent bound forms.



7.00.00 **CONTRACT STAGE DOCUMENT SUBMISSION AND APPROVAL
PROCEDURE**

7.01.00 Within fifteen (15) days of issue of Letter of Award (LOA) by the Owner, the Contractor shall furnish a schedule of drawings and design document to be submitted by him to the Owner/Engineer indicating dates against each document.

The documents shall be divided into two categories : a) for approval and b) for information/further engineering and co-ordination by the Owner.

In preparing this schedule, the Contractor shall allow four (4) weeks from date of receipt for review and comments by the Owner/Engineer for each submission of a document.

This document submission schedule shall require approval by the Owner/Engineer.

7.02.00 All contract documents shall be marked, without fail, with the name of the Owner, the Project, the specification title and number and the unit designation.

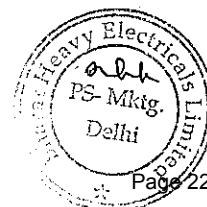
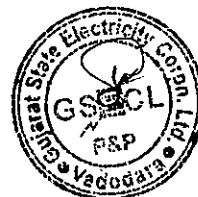
All dimensions shall be in metric units.

All notes, markings etc. shall be in English.

7.03.00 Documents/Drawings, submitted during tender stage, shall be revalidated or revised as required and submitted as certified contract document for approval / information of the Owner/Engineer.

7.04.00 Unless specified otherwise, the following categories of documents/drawings would require approval of the Owner/Engineer:

- a) List of sub-vendors (from Owner only)
- b) System scheme and instrumentation diagrams
- c) Design basis justifying selection of equipment & process parameters where not specified in the Contract
- d) Equipment data sheets and general arrangement drawings
- e) Materials of construction
- f) Layout drawings.
- g) Operation logic diagrams.
- h) Typical control circuit.
- i) Drawings of Instrumentation and control.



7.05.00 Unless specified otherwise, the following categories of documents/ drawings would be treated for information/further engineering by the Owner/Engineer. The Contractor shall, however, incorporate all additional information and clarifications in these documents / drawings as and when desired by the Owner/Engineer.

- a) Equipment foundation drawings.
- b) Equipment cross-section drawings, product literature etc. which are of proprietary nature.
- c) Predicted performance curves of equipment.
- d) Various bills of quantity, schedules etc.
- e) Piping fabrication drawings, isometrics etc.
- f) Panel wiring diagrams.
- g) Instruction/Operation manuals.
- h) Service manuals and trouble shooting guide for C & I system including field instruments.
- i) Cable schedule and interconnection chart.
- j) Drive/feederwise control scheme showing all external interfaces.

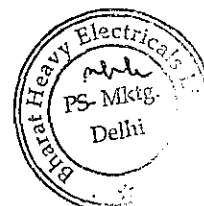
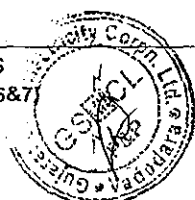
In essence, the Contractor is solely responsible for corrections and adequacy of design & engineering for documents under this category.

7.06.00 Upon review, the Owner/Engineer shall put his remarks and one of the following action stamps on the drawing/document:

- a) Approved.
- b) Approved except as noted, forward final drawing
- c) Approved except as noted, resubmission required.
- d) Disapproved.
- e) For information/reference only.

For action stamps in category (c) & (d), documents must be resubmitted for review by the Owner/Engineer. For action stamp in category (b), further review by Owner/Engineer would not be necessary provided the Contractor agrees & incorporates the comments made on the document.

Except for action stamp under category (c) & (d), the Contractor can proceed with manufacturing and other sequential activities for those areas of a drawing/document which do not have any review comment by the Owner/Engineer.



The Owner/Engineer may accord approval in category (c) or (d) in more than one submission of a document till he is satisfied that the intent of the specification has been fully complied with. The Contractor shall be responsible for delay in such cases and no extension of time shall ordinarily be allowed on such grounds. Approval of contract documents by the Owner/Engineer shall not relieve the Contractor of his responsibility for any errors and fulfillment of contract requirements.

The Contractor's work shall be in strict accordance with the finally approved drawings and no deviation shall be permitted without written approval of the Owner/Engineer.

7.07.00 Except key plan/general yard plan, any layout drawing requiring scrutiny shall not be drawn to a scale less than 1:50.

7.08.00 For review by the Consulting Engineer, the Contractor shall furnish soft copies of drawings & documents and three (3) prints of each drawing/document. Two (2) prints of such submission shall also be sent to the Owner. After review, comment/approval will be sent to the Contractor. Upon action under category (a) or (e), the Contractor shall directly distribute the documents to the various offices of the Owner and other agencies in number of copies as specified in the contract document. Such distribution copies shall be marked with the reference and date of the letter by which the Owner/Engineer has accorded his final approval. Penal action shall be taken against the Contractor for any unauthorised revision in the drawings so distributed from the drawings approved by the Owner/Engineer. The contractor shall furnish three (3) CDs of all as built/final drawings for Owner/Consultant site.

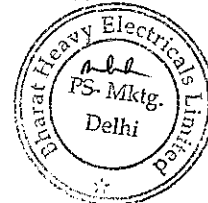
7.09.00 In case of contradiction between the stipulations above and those stated elsewhere in the specification, the stipulations herein shall prevail.

7.10.00 For details of documentation for Civil, Structural and Architectural works, Vol. II-G may be referred.

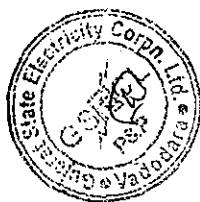
8.00.00 TENDER STAGE DOCUMENT SUBMISSION

8.01.00 The Bidder shall submit along with his bid all documents/drawings as requested in respective specifications. The documents shall include but not be limited to the following :

- a) All Bid proposal sheets duly filled up.
- b) Detailed experience list and financial resources of the prime bidder his collaborators/associates in this bid as well as the sub-vendors proposed.
- c) Scheme drawings indicating scope of supply and service as offered by the Bidder indicating clearly exclusions, if any.
- d) List of terminal points of the package offered together with quality and quantity of various input (i.e. water, air, electricity etc.) as required from the Owner at such interfaces.



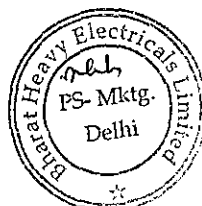
- e) Equipment GA, Layout, Design Calculations, interlock and other write-up, catalogues/literature etc. as required for clear understanding of the bid submitted.
- f) L-1 network indicating target dates for intermediate milestones and final commissioning of equipment supplied; This network shall be supplemented by a detailed write-up on proposal procedure of project implementation, deployment schedule for Key personnel with their bio-data, schedule of construction machinery etc.
- g) List of suppliers for all bought out items.



DEVELOPMENT CONSULTANTS
(K9213R-EPC-SPC-001-Vol-IIA-Sec-6&7)

V IIA/S-6 : 8

105

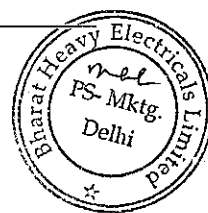


VOLUME : IIA
SECTION-VII
QUALITY ASSURANCE REQUIREMENTS



DEVELOPMENT CONSULTANTS
(K9213R-EPC-SPC-001-Vol-IIA-Sec-6&7)

106



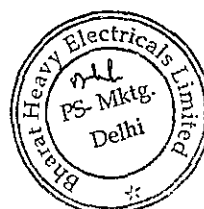
CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	QUALITY ASSURANCE PROGRAMME
2.00.00	GENERAL REQUIREMENTS QUALITY ASSURANCE
3.00.00	QUALITY ASSURANCE DOCUMENTS
4.00.00	INSPECTION, TESTING & INSPECTION CERTIFICATES
	ANNEXURES
ANNEXURE-I	FORMAT OF QUALITY ASSURANCE PROGRAMME
ANNEXURE-II	FIELD WELDING SCHEDULE



DEVELOPMENT CONSULTANTS
(K9213R-EPC-SPC-001-Vol-IIA-Sec-6&7)

107



VOLUME : IIA

SECTION-VII

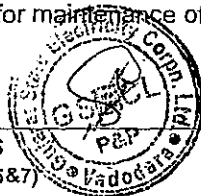
QUALITY ASSURANCE REQUIREMENTS

1.00.00 QUALITY ASSURANCE PROGRAMME

1.01.00 To ensure that the equipment and services under the scope of 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 or work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Owner/Authorised representative after discussions before the award of contract. A quality assurance programme of the Contractor shall generally cover the following :

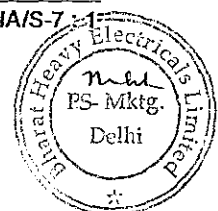
- a) His organisation structure for the management and implementation of the proposed quality assurance programme.
- b) Documentation control system.
- c) Qualification data for Bidder's key personnel.
- d) The procedure for purchase of materials, parts, components and selection of Sub-contractor's services 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 controls 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 all site related works.
- h) Control of calibration and testing of measuring and testing equipments.
- i) System for quality audit.
- j) System for indication and appraisal of inspection status.
- k) System for authorising release of manufactured product to the Owner.
- l) System for handling storage and delivery.
- m) System for maintenance of records.

DEVELOPMENT CONSULTANTS
(K9213R-EPC-SPC-001-Vol-IIA-Sec-6&7)



108

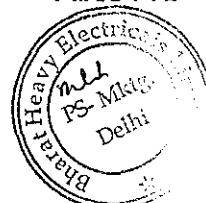
V IIA/S-7



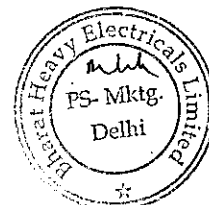
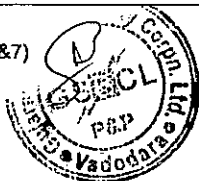
- n) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per format enclosed at Annexure-I to this section.

2.00.00 **GENERAL REQUIREMENTS - QUALITY ASSURANCE**

- 2.01.00 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the Contractor for some of the major items is given in the respective technical specification. This is however, not intended to form a comprehensive programme as it is the Contractor's responsibility to draw up and implement such programme duly approved by the Owner/Consultant. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder, separately in the format attached at Annexure-I and will be submitted to Owner/Authorised representative for approval. Schedule of finalisation of such quality plans will be finalised before award.
- 2.02.00 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's Quality Control organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing.
- 2.03.00 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's site Quality Control organisation, during various stages of site activities from receipt of materials/equipment at site.
- 2.04.00 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality plans and reference documents/standards etc. will be subject to Owner's approval without which manufacture shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans, Owner/Authorised representative shall identify customer hold points (CHP), test/checks which shall be carried out in presence of the Owners Engineer or his authorised representative and beyond which the work will not proceed without consent of Owner/Authorised representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner/Authorised representative for approval and dispositioning.
- 2.05.00 No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of all previous tests/inspections by Owner's Engineer/ Authorised representative, and duly authorised for despatch issuance of Material Despatch Clearance Certificate (MDCC).



- 2.06.00 Materials used or supplied shall be accompanied by valid and approved materials certificates and tests and inspection report as per Owner's approved QAP. These certificates and reports shall indicate the sheet numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it.
- 2.07.00 Castings and forgings used for construction shall be of tested quality. Details of results of chemical analysis, heat treatment record, mechanical property test results shall be furnished.
- 2.08.00 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section-IX/BS-4870 or other International equivalent standard acceptable to the Owner.
- All brazers, welders etc. employed on any part of the contract at Contractor's/ Sub-Contractor's works or at site shall be qualified as per ASME Section-IX or BS-4871 or equivalent international standard approved by the Owner. Such qualification tests shall be conducted in presence of Owner/his authorised representative.
- For welding of pressure parts and high pressure piping the requirements of IBR shall also be complied with.
- 2.09.00 All non-destructive examination (NDT) shall be carried out in accordance with approved international standard. The NDT operator shall be qualified as per SNT-TC-1A (of American Society of non-destructive examination). Results of NDT shall be properly recorded and submitted for approval.
- 2.10.00 All the sub-vendors proposed by the Contractor for procurement of major bought out items including castings, forgings, semi-finished and finished components/equipment list of which shall be drawn up by the Contractor and finalised with the Owner shall be subject to Owner's approval. Quality Plans of the successful vendors shall be discussed, finalised and approved by the Owner/Authorised representative and form part of the Purchase Order between the Contractor and the Vendor.
- 2.11.00 All the purchase specifications for the major bought-out items, list of which shall be drawn up by the Contractor and finalised with the Owner shall be furnished to the Owner for comments and subsequent approval before orders are placed.
- Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-vendor's quality management and control activities. The Contractor shall provide all necessary assistance to enable the Owner carry out such audit and surveillance.
- Quality audit/approval of the results of tests and inspection will not prejudice the right of the Owner to reject an equipment not giving the desired performance after erection and shall not in no way limit the liabilities and responsibilities of the Contractor in earning satisfactory performance of equipment as per specification.
- 2.12.00 Quality requirements for main equipment shall equally apply for spares and replacement items.



2.13.00 Repair/rectification procedures to be adopted to make any job acceptable shall be subject to the approval of the Owner.

2.14.00 For quality assurance of all civil works refer to the specifications for civil works.

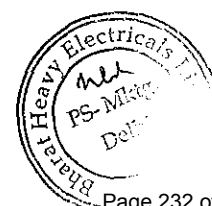
3.00.00 QUALITY ASSURANCE DOCUMENTS

3.01.00 The Contractor shall be required to submit two (2) copies and two (2) sets of microfilms of the following Quality Assurance documents within three (3) weeks after despatch of the equipment :

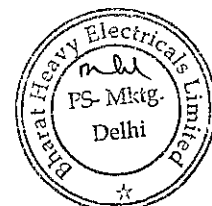
- a) Material mill test reports on components as specified by the specification.
- b) The inspection plan with verification, inspection plan check points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.
- c) Non-destructive examination results /reports including radiography interpretation reports.
- d) Factory tests results for testing required as per applicable codes and standards referred in the specification.
- e) Welder identification list listing welder's and welding operator's qualification procedure and welding identification symbols.
- f) Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
- g) Stress relief time temperature charts.
- h) Inspection reports duly signed by QA personnel of the Owner and Contractor for the agreed inspection hold points. During the course of inspection, the following will also be recorded :
 - i) When some important repair work is involved to make the job acceptable.
 - ii) The repair work remains part of the accepted product quality.
- i) Letter of conformity certifying that the requirement is in compliance with finalised specification requirements.

4.00.00 INSPECTION, TESTING AND INSPECTION CERTIFICATES

4.01.00 The Engineer, his duly authorised representative and/or an outside inspection agency acting on behalf of the Owner shall have access 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 on 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.



- 4.02.00 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 the 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 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 test reports in six (6) copies.
- 4.03.00 The Engineer or Inspector shall within fifteen (15) days from the date of Inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make 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.
- 4.04.00 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 fifteen (15) days after completion of tests but if the tests are not witnessed by the Engineer/Inspectors, 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 certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.
- 4.05.00 In all cases where the contract provides for tests whether at the premises or works of the Contractor or 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 representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Engineer/Inspector or to his authorised representative to accomplish testing.
- 4.06.00 To facilitate advance planning of inspection in addition to giving inspection notice as per Clause 4.02.00, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at customer hold point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.



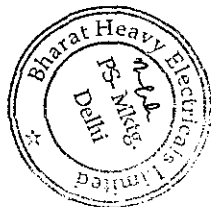
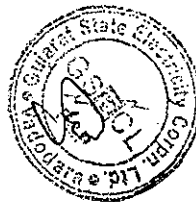
ANNEXURE-I

FORMAT OF QUALITY ASSURANCE PROGRAMME

Name of Company/ Contractor	NAME OF CONTRACT PACKAGE			QUALITY PLAN FOR						
	Package No. : _____			QP No. : _____ Date _____						
	Contractor : _____			Rev. No.: _____ Date _____						
Sl. No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check	Reference Document	Acceptance Norm	Format of Record	Agency	Remarks

Note: All the information for QAP as stipulated above shall be finalized and agreed during contract execution.

113



DEVELOPMENT CONSULTANTS
(K9213R-EPC-SPC-001-Vol-IIA-Sec-6&7)

V IIA/S-7 : 6

ANNEXURE-II

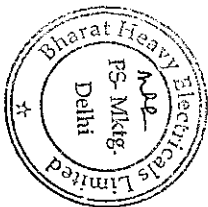
FIELD WELDING SCHEDULE

PROJECT : FWS NO :
CONTRACTOR : REV NO. :
PACKAGE : FIELD WELDING CODE :
SYSTEM : PAGE NO. :

Sl No.	Drawing No. for Weld Locations & Identification mark	Description of parts to be welded	Material specification	Dimensions	Process of Welding	Type of Weld	Electrode Filler Specification	WPS No.	Minimum Pre-heat Temperature	Heat Treatment Temperature [Holding Time in secs]	NDT Method Quantum	NDT Specification Number	Acceptance Norm Ref.	Remarks
--------	--	-----------------------------------	------------------------	------------	--------------------	--------------	--------------------------------	---------	------------------------------	---	--------------------	--------------------------	----------------------	---------

The Field Welding Schedule should be submitted for :

- o Pressure Parts
- o Tanks/Vessels
- o Piping
- o Heavy/Important Structural Steel
- o Heat Exchangers
- o Bus Ducts



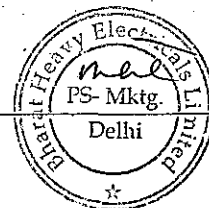
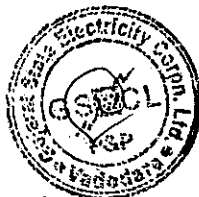
DEVELOPMENT CONSULTANTS
(K9213R-EPC-SPC-001-Vol-IIA-Sec-6&7)

V IIA/S-7 : 7

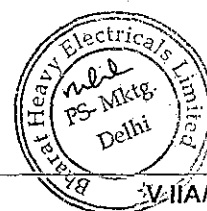
VOLUME : IIA

SECTION - X

PERFORMANCE GUARANTEES AND TESTS



- 1.04.00 The liquidated damages shall be calculated prorata for the fractional parts of the unit unless stated otherwise.
- 1.05.00 The turbine generator, boiler, auxiliaries, and all other plant equipment and system shall perform continuously without the noise level (individual or collectively) exceeding the values specified in respective equipment specification over the entire range of output and operating frequencies.
- 1.06.00 **Performance/Acceptance Tests**
- 1.06.01 The performance/acceptance tests for various equipment and systems shall be carried out as specified under the respective equipment specifications and those specified below shall be specifically applicable. All the guarantees shall be tested together as far as practicable.
- 1.06.02 In case of systems with stand-by equipment the liquidated damages for non-performance will be levied for normal operating number of equipment only. However, for this purpose all the equipment including standby equipment shall be tested and average values arrived at.
- 1.06.03 For instrument inaccuracies during PG Test, refer subsequent clauses of this section.
- 1.06.04 For Total Auxiliary Power Consumption, the transformers listed under the respective clauses, shall be taken together for purposes of guarantee and not individually.
- 2.00.00 **START-UP, INITIAL OPERATION, RELIABILITY RUN AND PERFORMANCE TESTS**
- 2.01.00 The Contractor shall provide commissioning & start-up supervisory engineering staff specially identified for the period commencing with start-up and extending from initial operation to all performance tests. During this period, the Contractor shall furnish the calibration devices, special test instruments, etc. required to prepare for and conduct the performance tests. The Owner will associate his operating personnel and necessary supporting staff and shall make available the main fuel; i.e. coal and the system electrical load.
- Contractor's commissioning, & start-up supervisory engineering personnel shall conduct training for the Owner's personnel prior to and during this period and shall train them so that they will be able to operate and maintain the new equipment satisfactorily after acceptance by the Owner.
- 2.02.00 The following field inspections and tests shall be carried out in the sequence detailed below, and the successful performance and completion of all the tests taken together shall constitute the Owner acceptance tests. The Contractor shall provide supervisory services during field inspection and tests.



2.02.01 Inspection and Checking of the Units

After completion of erection and/or installation, and before being put into operation, the unit and all its appurtenances shall be thoroughly cleaned and then inspected, for correctness and completeness of installation and acceptability for placing in operation. All piping system shall be flushed, chemically cleaned, steam blown, air blown as required and cleanliness demonstrated using acceptable industry standards. Procedures to accomplish this work shall be subject to Owner's approval.

The check outs during the pre-commissioning period should be programmed to follow the construction completion schedule. Each system, as it is completed by construction and turned over to the commissioning (start-up) engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed schedule.

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.

When the equipment is operating properly, its characteristics shall be recorded on the start-up report sheets. Copies of typical start-up report shall be given to the Owner. Start-up reports for all equipment shall be completed before the start of the Reliability Run.

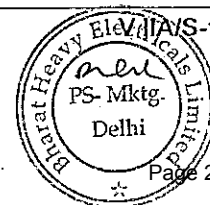
2.02.02 Initial Operation, Reliability Run

The plant shall be on Reliability Run 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.

The duration of Reliability Run of the complete plant & equipment in the automatic mode of control shall be fourteen (14) days out of which atleast seventy two (72) hours shall be in continuous operation on full load or any other duration as may be agreed to between the Owner and the Contractor. The Reliability Run shall be considered successful, provided such item of the equipment can be operated, continuously at the specified operating characteristics for the period of Reliability Run.

For the period of Reliability Run, the time of operation with minimum 85% load shall be counted, minor interruptions not exceeding one(1) to Two(2) hours at a time caused during the continuous operation shall not affect the total duration of Reliability Run. Maximum number of such interruption during the reliability run shall be four(4). However, if in the opinion of the Owner, the interruption is long, the Reliability Run shall be prolonged for the period equivalent to the duration of interruption.

A Reliability Run report comprising observations and recordings of various parameters to be measured, in respect of the above run shall be prepared by the Contractor. This report besides recording the details of the various observations during operation shall also include the dates of start and finish of the Reliability Run and shall be signed by the representatives of both the parties. The report shall have sheets, recording and print out of all the details of



interruption occurred, adjustments made, any minor repairs done during the Reliability Run. Based on the observations, necessary modifications/repairs to the plant shall be carried out to the full satisfaction of the Owner 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 withholding the aforesaid permission.

Should any major failure or interruption occur in any portion of the plant due to or arising from faulty design, materials, workmanship or omissions or incorrect erection, sufficient to prevent safe and full commercial use of the plant, the reliability run shall be considered void and the reliability test period of 14 days shall recommence after the Contractor has remedied the cause of defect.

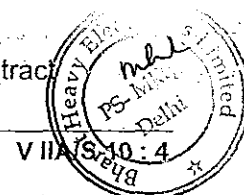
2.02.03 Performance and Guarantee Test

- a) The final tests as to the performance and guarantees shall be conducted at site, after the reliability run, by the Contractor with full involvement of the Owner. The necessary operating inputs shall be provided by the Owner. The Contractor's engineering staff for commissioning and start-up shall ensure that the equipment are ready for such tests. The Owner shall associate his necessary supporting staff with the Contractor to carry out the various activities related to PG tests. The necessary labour/supporting staff etc. shall be provided by the Contractor. Such tests will be conducted within a period of two (2) months after the successful completion of Reliability Run. Any extension of time beyond the above two (2) months shall be mutually agreed upon.
- b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the performance guarantees.

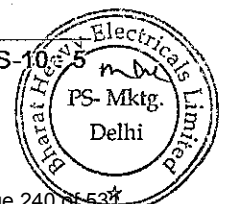
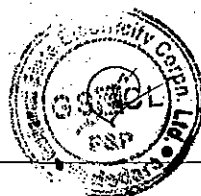
The Contractor shall submit the test procedure for Owner's approval within twelve (12) months from the date of letter of award of the contract. The test shall be carried out by the test grade instruments as stipulated in the applicable test code. These instruments shall be calibrated by the Contractor in a laboratory duly approved by Owner. Batch calibration will not be acceptable. The available instrumentation and control equipment in the plant if found suitable could also be used with the prior approval of the Owner after calibrations in the plant/outside laboratory. The tests will be conducted at the specified load points, and as near the specified cycle conditions as practicable. Proper corrections in calculations to take into account the conditions which do not correspond to the specified conditions will be applied in the test report as brought out under the respective sections of the specification.

The contractor shall submit for Purchaser's approval the detailed Performance Test procedure containing the following :

- i. Object of the test
- ii. Scope
- iii. Various guaranteed parameters & tests as per contract



- iv. Method of conductance of test and test code
 - v. Duration of test, frequency of readings & number of test runs.
 - vi. Method of calculation
 - vii. Correction curves
 - viii. Instrument list consisting of range, accuracy, least count and location of instruments.
 - ix. Scheme showing measurement points
 - x. Sample calculation
 - xi. Acceptance criteria
 - xii. Any other information required for conducting the test.
- c) All special test grade instruments, including flow nozzles etc., equipment, tools and tackles, required for the successful completion of the Performance and Guarantee Tests shall be brought for the purpose of test, free of cost by the Contractor.
- d) The guaranteed performance figures of the equipment shall be proved by the Contractor during these Performance and Guarantee Tests. The Contractor shall submit a detailed test report in the manner, already agreed to within one (1) month time of completion of the test, for Owner's approval. Should the Owner's assessment of these tests show any deterioration from the guaranteed values the Contractor/Owner shall modify the equipment as required to enable it to meet the guarantees. In such case Performance and Guarantee Tests shall be repeated after one (1) month, from the date the equipment is ready for retest and all costs 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.
- e) The specific tests to be conducted on equipment have been brought out in the technical specifications. The procedure to be submitted by the Contractor should include the detailed methodology to conduct these tests/verify the guarantees offered by the Contractor notwithstanding whether these attract liquidated damages or not.
- f) The test results shall be considered as calculated from test observations with only corrections as are provided in the code ASME PTC-6.
- The guaranteed parameters shall be without any tolerance or allowance values. Uncertainty analysis shall not be used to adjust test results.
- g) The Bidder shall establish the following modes of operation to the satisfaction of the Owner before acceptance test :
- i. Operation of each system by remote manual control.
 - ii. Operation of the entire system in integrated manner on auto control.



- iii. Operation of the entire plant with auto-control loops fully implemented including different modes of load control with the help of control system.

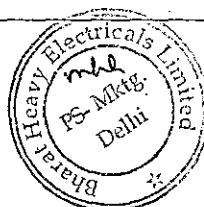
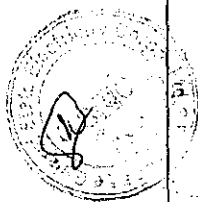
- h) Ten (10) copies of the test reports are to be furnished by the Contractor to the Owner backed up with jointly signed data sheets.

Wherever it is not practicable to conduct the performance guarantee test at site, and an accurate test to prove the guaranteed parameter has already been conducted in the shop test, such a test may not be repeated, if so agreed by the Owner. However, in such cases, should there be any short fall in the performance during shop tests, the liquidated damages will be calculated on that basis.

3.00.00

**SCHEDULE OF GUARANTEES WHICH ATTRACT LIQUIDATED DAMAGES
[CATEGORY-A]**

Sl. No.	Plant/ System	Parameter for Performance Guarantee	Liquidated Damages
3.01.00	Plant		
3.01.01	Guaranteed Output	800 MW Continuous output at 100% TMCR, at Generator terminals (excluding excitation power), at 0.85 power factor lagging and at rated hydrogen pressure and 39°C cooling water temperature for Generator, under rated steam conditions at Turbine Inlet ($250 \pm 3 \text{ kg/cm}^2$, $566 \pm 3^\circ\text{C}$, 593°C) and CW temperature of 33°C for condenser and with zero percent make-up.	As per Volume-I.
3.01.02	Guaranteed Overall Heat Rate	Overall Heat rate in Kcal/Kwh at 100% & 80% TMCR under rated steam conditions at turbine inlet & design condenser vacuum and cooling water temperature of 33 deg C with zero make up. (Refer Note-1 for estimation of overall Heat Rate)	As per Volume-I.
3.01.03	Guaranteed Total Auxiliary Power Consumption	Total Auxiliary power consumption (kW) of the plant on the basis of measured output at Generator terminals minus sent out power measured downstream of Generator Transformer and station transformer at 100% TMCR with rated steam conditions and design condenser vacuum with zero make-up and with 34°C ambient air temperature and 65% RH (Refer Note 2, 3 & 4 for the basis of computation of Auxiliary power)	As per Volume-I.



Sl. No.	Plant/ System	Parameter for Performance Guarantee	Liquidated Damages
3.02.00	System		
3.02.01	Guaranteed DM Water Consumption	Continuous consumption of DM water in m ³ /hr.	As per Volume-I.

Note :

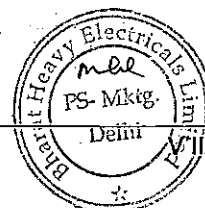
- For items 3.01.02, Overall Heat Rate shall be estimated as follows :

$$a) \quad \text{Overall Heat Rate} = \frac{\text{Turbine Cycle Heat Rate}}{\text{Boiler Efficiency}}$$

For estimation of turbine cycle heat rate, refer Cl. No. 4.01.00 in Vol-II-C-Sec.01.

$$b) \quad \text{Guaranteed Overall Heat rate} = \frac{\text{HR at 80\% TMCR} \times 1955 \text{ hrs} + \text{HR at 100\% TMCR} \times 6320 \text{ hrs}}{(1955 + 6320)}$$

- For computation of Auxiliary Power, output measured at Generator terminals minus sent out power measured downstream of Generator Transformer, applicable Losses (No load loss + Load loss+ auxiliary loss for coolers) for Station Transformers, Unit Transformers and Bus duct losses shall be considered.
- For intermittent running auxiliaries i.e., AC & Ventilation system, and outdoor area Illumination, a duty factor of 0.5 shall be considered.
- For computation of auxiliary power consumption of Ash Handling Plant, Bidder to follow the methodology as below :
 - Duty factor for Lean Slurry Bottom Ash System shall be considered as 0.3.
 - Duty factor for Dry Fly Ash System shall be considered as 0.6.
 - Duty factor for HCSD & Ash Water Recovery System shall be considered as 1.0.
- For auxiliary power consumption of coal handling plant following shall be considered :
 - Total power consumption of all conveyor drives and other equipments shall be at the guaranteed design capacity of 1400 MTPH with flow path from Wagon Tippler to Boiler Bunker.
Single Stream Operation.
Duty Factor = 0.5.



6. Power consumption for Fire Pumps, Sump Pumps and Fuel oil transfer system drives, Elevators, EOT Cranes shall not be considered in the Auxiliary Power consumption estimate.
7. Heat Rate of TG Cycle : Maximum 1850 Kcal/Kwh with Steam Turbine driven BFP.
8. Steam Generator Efficiency : More than 87%
9. Auxiliary Power Consumption shall be limited to 6% with Steam Turbine driven BFP.
10. Bidder has to furnish the expected availability of plant & plant reliability.

4.00.00 **SCHEDULE OF GUARANTEES WHICH DO NOT ATTRACT LIQUIDATED DAMAGES FOR VARIOUS EQUIPMENT WHICH INCLUDE BUT ARE NOT LIMITED TO THE FOLLOWING [CATEGORY-B]:**

4.01.00 **Steam Generator**

- 4.01.01 Capacity in T/hr of steam at rated steam parameters at superheater outlet (with any combination of mills working as per Owner's discretion) and the coal being fired within range specified, corresponding to 100% BMCR at 1% make up, 33 deg.C CW temperature and auxiliary steam consumption.

Bidder shall consider necessary provision for demonstration of steam generation at 100% BMCR condition.

- 4.01.02 Efficiency in percentage at 100% & 80% TMCR and 34 deg. C ambient air temperature and 65% RH with zero make-up, design condenser vacuum while firing the design coal at rated steam parameters at Superheater and Reheater outlet and rated excess air and with any combination of mills working as per Owner's discretion.

- 4.01.03 Air heater air-in-leakage after 3000 hrs. of operation from taking over date. To be demonstrated.

- 4.01.04 NOx emission.

NOx emission from the unit – shall not be more than 365 ppm or 750 mg/Nm³ (equivalent NO₂) at the ESP outlet at 6% excess oxygen.

- 4.01.05 Mill capacity at rated fineness.

- 4.01.06 Gas tightness efficiency of Guillotine dampers.

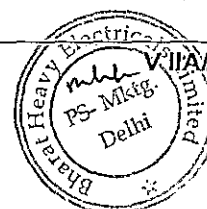
- 4.01.07 Bidder to demonstrate the steam parameters at 30% load without HFO/LDO support (only coal firing). No fuel oil support shall be required at 30% of BMCR and above.

- 4.01.08 Performance characteristics of pumps, fans, etc. viz; capacity, head developed etc.



DEVELOPMENT CONSULTANTS
(K9213R-EPC-SPC-001-Vol-IIA-Sec-10.doc)

199



VIIA/S-10 : 8

- 4.01.09 Capabilities of all drives.
- 4.01.10 Margins on fans. Through operation of single fan at a time.
- 4.01.11 Equal load sharing of pumps/fans while running in parallel shall be demonstrated.
- 4.01.12 Run back capabilities.
- 4.01.13 Ramp/sudden load change withstand capability. Sudden load throw off typically 25%, 50%, 75% and 100% shall be demonstrated.
- 4.01.14 Life of mill wear parts
- 4.01.15 Steam Temperature Imbalance

The Bidder shall guarantee and demonstrate that at SH and RH outlets (in case of more than one outlet) the temperature imbalance between the outlets does not exceed 10 Deg.C.

4.01.16 SH/RH Attenuation System

The Bidder shall guarantee and demonstrate that the spray water flow to SH attenuation system does not exceed the value considered for design (to be indicated in the bid) while maintaining the rated SH outlet steam temperature at BMCR. The Bidder shall also guarantee and demonstrate that the RH temperature is maintained at the rated value without any spray water requirement, for the secondary attenuation system, at all loads for which the specified RH steam temperature is required to be maintained at the rated value.

4.02.00 Electrostatic Precipitator

4.02.01 Pressure drop across the electrostatic precipitator.

4.02.02 Collection efficiency and outlet dust concentration shall be as per cl. no. 3.01.00 of Section-II in Volume-II-B.

4.03.00 Turbine Generator

4.03.01 Turbine Generator-Set Capability

The steam turbine generator unit shall be capable of delivering continuously at generator terminals the output as indicated by the Bidder in the following heat balances detailed out elsewhere with equipment specification submitted along with the bid.

- a) Output corresponding to top HP heaters out of operation (for 1x100% HP heater configuration).
- b) Output corresponding to one string of HP heater out of operation (for 2x50% HP heaters configuration).
- c) Output corresponding to all HP heaters out of operation.



- d) Output corresponding to VVO rating, at rated steam conditions with condenser CW temperature 33°C & design condenser vacuum with zero make-up.
- e) Output corresponding to overpressure operation of the boiler-turbine-generator set, at rated main steam and hot reheat steam temperature with condenser CW temperature corresponding to design Condenser vacuum with zero make-up.

4.03.02 Operating Frequency Range

As per the stipulations of Cl. No. 7.06.00 Vol. II-C, Section-I.

4.03.03 Constant Pressure and Sliding Pressure Operation

The constant pressure operation and sliding pressure operation from 30% turbine MCR to VVO condition of the unit in conjunction with the steam generator, HP-LP bypass system and instrumentation & control system shall be demonstrated.

In sliding pressure mode of operation, during quick load increase the idle control valve (s) must respond rapidly to pick up 20% of operating load, so that immediate increase of boiler pressure is not required. The load response capability shall be demonstrated in steps of 5 %.

Change-over from constant pressure mode to sliding pressure mode and vice-versa shall also be demonstrated.

4.03.04 Start-up, Loading, Unloading and Shutdown Capabilities

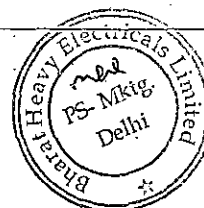
Start-up, loading, unloading and shutdown characteristics and startup time and loading capabilities for the steam turbine generator and steam generator both operating as a unit for cold start conditions (greater than 36 hours shutdown), warm start conditions (between 8 and 36 hours shutdown) and hot start conditions (less than 8 hours shutdown) under constant pressure and variable pressure mode and suitability for cyclic operation as indicated by the Bidder in the offer and accepted by the Owner shall be demonstrated ensuring the parameters of vibration, differential expansion, etc.

4.03.05 Vacuum Pulling time

Vacuum pulling time from condenser at atmospheric pressure to rated vacuum compatible to start Steam Turbine

4.03.06 Sudden Total Loss of External Load

On occasions, the steam turbine generator system may experience sudden total loss of all external load. Under these conditions, the steam turbine generator unit shall not trip on overspeed but shall continue in operation under the control of its speed governor to supply power for the plant auxiliary load station transformers, while staying within the prescribed permissible limits of steam metal temperature mismatch, exhaust hood temperature, absolute and differential expansion, vibration and eccentricity acceptable to the Owner.



4.03.07 Capacity with Reduced Hydrogen Pressure

Generator shall be capable of operating at reduced capacity at reduced generator hydrogen pressure in accordance with values furnished by the Bidder in his proposal and accepted by the Owner.

4.03.08 HP/LP Bypass Capabilities

i. HP/LP bypass capacity and capabilities under various modes of operation shall be demonstrated.

ii. Condenser performance with HPLP Bypass operating at rated conditions.

4.03.09 Lube Oil Purification System - Capacity and Purity

Lube oil purification system capacity and the purity of purified oil at the outlet of the centrifuge and the outlet of the polishing filter, shall be demonstrated. If purity check is not possible at site, this shall be carried out at Vendor's works.

4.03.10 Extraction and CRH NRVs

Operation of the valves under turbine trip and high water level in the heaters, shall be demonstrated.

4.03.11 The performance of the condenser, i.e., the back pressure achieved at design CW flow and inlet temp. and cleanliness factors, VWO heat load shall be demonstrated.

4.03.12 Temp. of condensate at outlet of condenser shall not be less than saturation temp. corresponding to the condenser pressure at all loads.

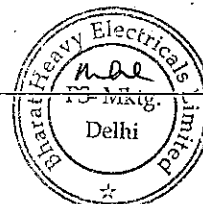
4.03.13 Oxygen content in condensate at hot-well outlet shall not exceed 0.015 cc/litre over the entire load range and shall be determined according to an internationally approved codes/standard.

4.03.14 When one half of the condenser is isolated, condenser capability shall be demonstrated to take at least 60% T.G. load under TMCR conditions.

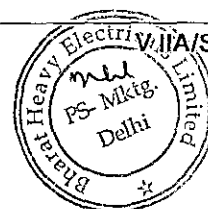
4.04.00 Deaerator

4.04.01 The dissolved oxygen content in feed-water measured at deaerator outlet shall not exceed 0.005 cc/litre at all loads from no load to VWO condition with 1% cycle make-up with normal pressure and overpressure with incoming condensate presumed to be saturated with oxygen (without any chemical dosing).

4.04.02 Free carbon dioxide in deaerator effluent shall be non-traceable at all loads from zero to VWO with 1% cycle make-up with normal pressure according to ASTM standards.



- 4.05.00 **Power Cycle Pumps**
- Performance of each pump (flow, head, vibration, noise, parallel operation) to be demonstrated.
- 4.06.00 **Automatic On Line Turbine Testing (ATT) System**
- Demonstrated without disturbing normal operation.
- 4.07.00 **Coal Handling Plant**
- Refer Cl. No. 11.00.00 in Volume-II-K/1.
- 4.08.00 **Condensate Polishing Unit**
- Bidder shall ensure that condensate temperature for CPU shall not go beyond 50°C during normal steady state operation.
- 4.09.00 **DM Plant**
- Performance Gurantee of DM plant shall be in accordance with Cl. No. 8.04.00 in Section-1, Volume-II-K/3.
- 4.10.00 **Instrumentation and Control**
- The Bidder shall demonstrate that the Instrumentation and Control system meets all the functional/performance requirements, specified in technical specifications.
- 4.11.00 **Noise Level**
- The Bidder shall demonstrate Noise Level of various plants/equipments/ systems as per Clause no. 17.02.00 in Section-IV of Volume-II-A.
- 5.00.00 **PERFORMANCE/ACCEPTANCE TESTS PROCEDURES**
- 5.01.00 **Steam Generator**
- The performance tests shall be conducted in accordance with the latest version of ANSI PTC 4.0 except for the specific requirements brought out herein below. This test may be done simultaneously or immediately after P-G test of Turbine Generator set. During this test, Boiler unit shall be fully on automatic control under steady load condition.
- 5.01.01 The efficiency tests shall be carried out with the steam generator operating at the guaranteed point condition i.e. corresponding to 100%, 80% Turbine rated loads, or at the agreed loads as near these as possible, with the boiler operating at the rated excess air, rated SH/RH attemperation flows, flue gas temperature, coal fineness, etc. corresponding to the loads on boiler. At control load, the stable and efficient operation of the unit with the rated excess air, rated mill outlet coal fineness, while achieving the rated S/H, R/H steam parameters shall be demonstrated by the Contractor to the satisfaction of the Owner.



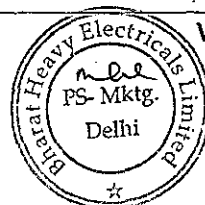
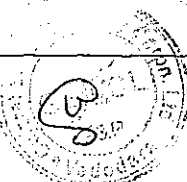
- 5.01.02 For finding out the performance values, two sets of consistent reading shall be taken and the average of the above values shall be considered for the guarantee purpose.
- 5.01.03 Corrections shall be applied to the tested efficiency, to correct it to the design conditions, for variations in the following parameters only :
- a) Feed water temperature at economiser inlet.
 - b) Ambient air temperature
 - c) Relative humidity of ambient air.
 - d) Hydrogen in coal.
 - e) Moisture in coal.
 - f) Gross calorific value of coal.

The Bidder shall furnish correction curves, for Owner's approval, covering the expected ranges of variations for all these parameters for the range of coals specified.

- 5.01.04 In all other aspects, not spelt out above, or in specifications, where ANSI code stipulates agreement between the parties concerned before the test, Bidder shall get these approved by the Owner.
- 5.01.05 No negative tolerance on account of instrument in-accuracies or otherwise shall be allowed on the guaranteed values.
- 5.01.06 Performance tests shall also be conducted to prove the steam generating capacity of the steam generator at rated parameters at stipulated loads.
- 5.01.07 Necessary write ups, schemes, instrument schedules, detailed procedures clearly indicating periods of tests, frequency of observations, etc. shall be prepared and submitted for all the tests for Owner's review and shall be got specifically approved from the Owner within one year of L.O.A. issue.

5.02.00 Mill Performance Warranty

- 5.02.01 Performance testing shall be done on the mill towards establishing its capacity specified at the specified fineness applying corrections for the variations in coal characteristics i.e. HGI, moisture, etc.
- 5.02.02 The Bidder shall guarantee a capacity output not less than the offered value, at each mill outlet, with coal fineness of not less than 70% through 200 mesh and not less than 98% through 50 mesh screen, when grinding coal having specified grindability index, total moisture content including surface moisture, etc. Bidder shall guarantee that the above capacity will be maintained and demonstrated with the originally installed grinding elements in nearly wornout condition as mutually agreed for the purpose of ascertaining wear life of any of the wear parts or when pulveriser grinding elements have successfully completed the specified guaranteed hours of operation as mentioned by the



Bidder, whichever is earlier. During the above mentioned operating period of the mill, manufacturer's operation instructions will be followed and mill will be operated with the specified range of coal without any such readjustment that requires a shutdown of the mill or reduction of the load and/or any replacement of any mill wear parts.

For the purpose of testing to demonstrate the capacity, if grindability and surface moisture vary from those given above, the pulveriser measured capacity shall be corrected using the capacity correction curves furnished by the Bidder alongwith the offer. HGI vs grindability factor curve shall be furnished for HGI variations upto a value above which the capacity remains constant.

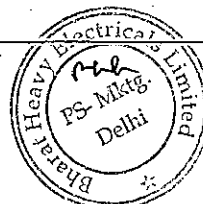
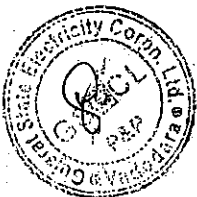
Capacity guarantee shall be conducted on all the mills. However, should the results of test as conducted above indicate that deficiency in capacity guarantee is observed in case of one or two mills only and that Owner is further, convinced that such deficiency does not occur out of reasons attributable to mill manufacture and supplier, Owner may waive off the requirement of demonstration of capacity guarantee for such mills only.

5.02.03 Mill Wear part life guarantee

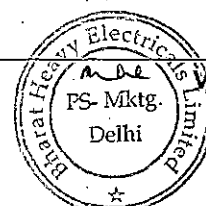
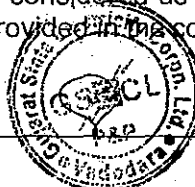
The Bidder shall guarantee the wear life of all wear parts of the mill when grinding the specified range of coals. For this purpose the wear parts shall be defined as those parts of the mill which are in contact with coal or coal dust and are likely to wear out during the operation of the mill (except for the grinding media balls). The guarantee shall be demonstrated on each mill after establishing successful operation of the mill continuously for a period of not less than 24 hours at or near its guaranteed rated capacity. The establishment of the guarantee will be based on actual total hours of operation of the mill regardless of the specified range of coal or fuel loading. The mill wear parts shall be considered to have passed their guaranteed operating life when they have demonstrated their capability to meet the full load rated capacity of the mill at the rated power consumption at the end of the guarantee trial period. In case any of the wear parts has worn out to such an extent that either the normal and safe operation of the mill is jeopardised if it is not replaced/repaired or its continued use may lead to exposure or wear of other parts which are not meant for the purpose, that part shall be deemed to have completed its life for the purposes of checking the short fall in wear life even if there is no reduction in mill rated capacity and rated power consumption shall be as quoted by the Bidder when grinding the coal having parameters specified in Vol-II-A, Section-IX and achieving the grind fineness of not less than 70% through 200 mesh and 98% through 50 mesh.

5.03.00 Electrostatic Precipitator

5.03.01 The performance test on electrostatic precipitator will commence after completion of reliability run along with the testing of Boiler and Turbine. During the interval between the commencement of trial operation and the commencement of performance test only routine maintenance shall be carried out. No physical or chemical cleaning of ESP shall be permitted during this period or immediately before the conductance of the performing tests.



- 5.03.02 The test efficiency shall be based on the overall performance of the electrostatic precipitator over a mutually agreed period of operation under the conditions given in this specification and following the normal operation of the unit including rapping and normal soot blowing and/or warm up guns. Outlet dust concentration of ESP shall be as specified in relevant section under Steam Generator subject to applicable modification adopted by Environmental Department, Government of India, at the time of project execution.
- 5.03.03 The performance tests shall be carried out in accordance with Method-17 of EPA (Environmental Protection Agency of USA) code. The details of the tests shall, however be mutually agreed upon between the OWNER and the CONTRACTOR.
- 5.03.04 All calibration procedures and standards shall be subjected to the approval of the Owner. The protecting tubes, pressure connections and other test connections required for conducting guarantee test and maintenance testing shall conform to the relevant codes. The Bidder shall fully elaborate, in his proposal, the provisions made to this effect. Method of measurement for all air leakage test and power consumption test proposed by the Bidder shall be clearly indicated in his offer, and shall be subject to Owner's approval.
- 5.04.00 **Turbine Generator**
- 5.04.01 The performance test for the turbine generator set shall be conducted in accordance with the latest edition of ASME-PTC-6 - full scale test method.
- The test results shall be considered as calculated from test observations with only corrections as are provided in the Code PTC-6.
- The guaranteed parameters shall be without any tolerance or allowance values. Uncertainty analysis shall not be used to adjust test results.
- For determination of primary flow to the turbine, low beta ratio throat tap nozzle assembly including required machined straight length meeting the requirements of ASME-PTC-6 shall be provided.
- 5.04.02 The performance tests shall be carried out to determine compliance with the following heat balance conditions :
- a) 100% TMCR condition under rated steam parameters at condenser CW temperature 33°C and design condenser vacuum with zero make-up.
 - b) 80% TMCR condition under rated steam parameters, at condenser CW temperature 33°C and design condenser vacuum with zero make-up.
- 5.04.03 The test heat rate under the above load conditions shall be computed as per relevant clause of T.G. Specification.
- The performance test shall be carried out with Turbine driven BFPs in service. To account for the conditions during the conductance of the test which do not correspond to the specified conditions, necessary corrections shall be applied.
- 5.04.04 The test results shall be considered as calculated from test observations with only corrections as are provided in the code ASME PTC-6.



The guaranteed parameters shall be without any tolerance or allowance values. Uncertainty analysis shall not be used to adjust test results.

- 5.04.05 The tests shall be arranged in a manner such that the Owner's operation is not disrupted. Duplicate test run will be performed at the 100% and 80% unit loads. The test results of corrected heat rate of the duplicate test runs shall agree within 0.25%. If they differ by more than 0.25% a third test shall be run at the same test points. Corrected results of anyone of the three test runs which deviates from the corrected average heat rate of all the runs by more than 0.25%, shall be eliminated, otherwise the results of the test with the highest heat rate figure will be considered.

The test for TG test capacity shall be carried out alongwith the heat rate test. Instrumentation and other details shall comply as above.

- 5.04.06 Condenser

Performance test for the condenser shall be conducted in accordance with the latest edition of ASME PTC-12.2. The condenser pressure shall be measured at 300 mm above the top row of tubes under VWO condition, zero make-up and design CW flow and CW inlet temperature corresponding to guranteed vacuum. The cleanliness factor shall be determined in accordance with the latest edition of ASME PTC-12.2.

- 5.04.07 Feed Water Heaters and Drain Cooler

Performance test for feed water heaters shall be conducted in accordance with the latest edition of ASME PTC-12.1.

- 5.04.08 Deaerator

Performance test for deaerator shall be conducted in accordance with the latest edition of ASME PTC-12.3.

The dissolved oxygen content in feed water at outlet of deaerator shall be determined by ASME-D 888. Reference Method A and any recognised modification thereof.

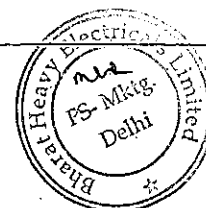
Free carbondioxide content of deaerator effluent shall be measured by APHA method.

- 5.05.00 **Statutory Requirements**

All parameters of plant, equipment & facilities which are under jurisdiction of Statutory Authorities, like MOEF, GPCB etc., shall be guaranteed. Conformance to the performance parameters under statutory requirement is mandatory.

- 5.06.00 **Remaining Plant and Equipment**

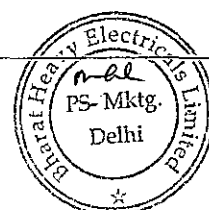
For other equipment, plants and systems, the performance test shall be carried out as per the respective equipment specification and the applicable codes.



VOLUME : IIA

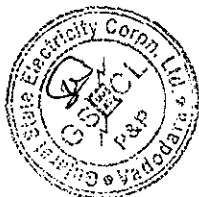
SECTION-VIII

**REQUIREMENTS OF SPARES, TOOLS & TACKLE,
LUBRICANTS/OIL/CONSUMABLES**



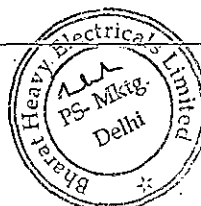
CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	TOOLS AND TACKLE
2.00.00	SPARES
	ANNEXURES
ANNEXURE-I	MANDATORY SPARE LIST



DEVELOPMENT CONSULTANTS
(K9213R-EPC-SPC-001-Vol-IIA-Sec-8.doc)

116



VOLUME : IIA

SECTION-VIII

REQUIREMENTS OF SPARES, TOOLS & TACKLE,
LUBRICANTS/OIL/CONSUMABLES

1.00.00 TOOLS & TACKLE

The Contractor shall supply with the equipment one complete set of special tools and tackles required for the erection, assembly, dis-assembly & maintenance of the equipment. These special tools will also include special material handing equipment, jigs & fixtures for maintenance and calibration/re-adjustment, checking & measurement aids etc. A list of such tools & tackles shall be submitted by the Bidder along with the offer. Detailed description of each tool/tackles, its function along with the equipment/part for which it is meant for and the price of each tool/tackles shall also be indicated in the offer. These tools & tackles shall be separately packed and sent to site before the first unit commissioning. The Bidder shall also ensure that these tools are not used for erection purpose.

2.00.00 SPARES

2.01.00 General

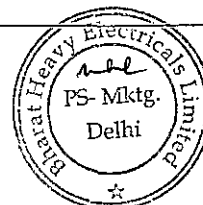
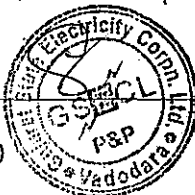
The Bidder shall indicate and include in his scope of supply all the necessary start-up, commissioning and recommended spares in addition to mandatory spares as specified elsewhere in the specification. The Owner reserves the right to buy any or all mandatory and recommended spares. The Contractor shall also state for each item of spares both mandatory and recommended, the normal expected service life.

2.01.01 All spares supplied under this contract shall be strictly interchangeable with the parts for which they are intended to replace. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site, e.g. small items shall be packed in sealed transparent plastic bags with dessicator packs as necessary.

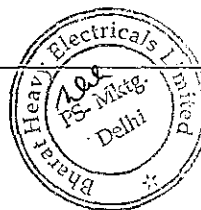
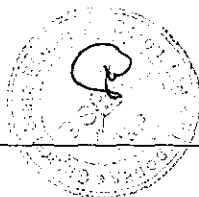
2.01.02 Each spare part shall be clearly marked or labelled on the outside of the packing with the description. When more than one spare part is packed in a single case, a general description of the contents shall be shown on the outside and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purposes of identification.

2.01.03 All cases, containers or other packages are liable to be opened for examination as may be considered necessary by the Engineer.

2.01.04 All mandatory spares shall be delivered to site within one to three months prior to the scheduled date of the trial operation of the plant. However, they shall not be despatched before the despatch of the associated main equipment.



- 2.01.05 The Bidder shall also guarantee supply of spare parts, which will be made, based on manufacturer's drawings on special order from the Purchaser for 30 years after commissioning of the plant.
- 2.01.06 Warranty period for all kinds of spares shall be six thousand (6000) hours of operation, except normal wear or eighteen (18) months from the date of receipt at site, whichever is later. In case of failure or non-conformance to specifications, the Contractor shall replace them free of cost.
- 2.02.00 **Recommended Spares**
- 2.02.01 The Contractor shall provide a list of recommended spares giving unit prices and total prices for 2 years of normal operation of the plant for spares of indigenous origin, and for 5 years of normal operation for spares of non-indigenous origin. This list shall take into consideration the mandatory spares specified elsewhere in the specification and should be a separate list.
- 2.02.02 The price of recommended spares will not be used for the evaluation of bids. The price of these spares shall remain valid for a period as specified elsewhere in the specification from the date of Award of the Contract. Where the recommended spares are the same as mandatory spares, the prices shall be the same. The prices of any recommended spares, which are not common with mandatory spares, shall be subject to review by the Owner, and shall be finalised after mutual discussion.
- 2.03.00 **Start-up Commissioning Spares**
- 2.03.01 Start-up commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. All spares used until the plant is handed over to the Owner shall come under this category. Said spares, properly marked, shall be supplied together with the main equipment and shall be used by the Contractor, if needed, during erection & commissioning stage. All such spares which remain unused till issuance of Taking Over Certificate by the Owner, along with an equipment-wise quantitative consumption report shall be returned to the Owner during time of handover. The list of commissioning spares to be brought by the Contractor to ensure smooth commissioning of the plant shall be subject to the Engineer's approval.
- 2.03.02 The Contractor shall submit a complete list of all such start-up spares. Costs of the above spares, which are consumed before the handing-over of the plant, shall be deemed to have been included in the lump sum proposal price of the package, and the Contractor shall have no claim on this account to the Owner.
- 2.04.00 **Mandatory Spare Parts**
- 2.04.01 The Owner considers some of the spares are essential for running the equipment irrespective of whether they are included in the list of recommended spares by the Bidder as mentioned above.



Since the components involved can not be foreseen at the bidding stage, only broad requirements of the Owner in this respect are outlined hereinafter. The bidder shall include his proposal, on the basis of this guideline, an item-wise list of all components and the quantity, unit prices & total price thereof, offered as mandatory spares for each and every equipment. This list shall be separate from the list of recommended spares and shall be used for bid evaluation purposes. Any clarification in this respect may be obtained by the Bidder at the pre-bidding stage.

- 2.04.02 Since the components involved can not be foreseen at the bidding stage, only broad requirements of the Owner in this respect are outlined hereinafter. The Bidder shall include in his proposal, on the basis of these guidelines, an item-wise list of all components and the quantity, unit prices & total price thereof, offered as mandatory spares for each and every equipment. This list shall be separate from the list of recommended spares and shall be used for bid evaluation purposes. Any clarification in this respect may be obtained by the Bidder at the pre-bidding stage.
- 2.04.03 The mandatory spares should be supplied to the Owner at least one month before the trial run. The despatch programme is subject to approval of the Owner/Consultant after award of contract.
- 2.02.04 Criteria for selection of Quantity of Mandatory Spares :
- For Mandatory Spares refer Annexure-I.
- 2.04.05 Purchaser will have the option to procure any or all of the mandatory spares at his discretion.





**1x800 MW WANAKBORI STPP
TECHNICAL SPECIFICATION FOR
EFFLUENT TREATMENT PLANT**

SPECIFICATION No: PE-TS-408-164-A001

VOLUME: II B

SECTION : C-3

REV. 00

DATE:

**SECTION: C-3
TECHNICAL SPECIFICATION (ELECTRICAL PORTION)**



TITLE:

**ELECTRICAL EQUIPMENT SPECIFICATION
FOR
EFFLUENT TREATMENT****1 X 800MW WANABORI TPS**SPECIFICATION NO. PE-TS-408-
164-A001VOLUME NO. : **II-B**SECTION: **C**REV NO. : **00** DATE: 08/04/2015

SHEET: 1 OF 1

CONTENTS

SECTION	TITLE	NO OF SHEETS
C	SPECIFIC TECHNICAL REQUIREMENTS	2
C	ELECTRICAL SCOPE BETWEEN BHEL & VENDOR	2
C	ELECTRICAL LOAD DATA FORMAT	1
C	TECHNICAL SPECIFICATION FOR MOTORS	28

	TITLE: ELECTRICAL EQUIPMENT SPECIFICATION FOR EFFLUENT TREATMENT 1 X 800MW WANABORI TPS	SPECIFICATION NO. PE-TS-408-164-A001
		VOLUME NO. : II-B
		SECTION: C
		REV NO. : 00 DATE: 08/04/2015
		SHEET: 1 OF 1

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

The equipment and services to be provided by bidder under this specification shall be as detailed here below but shall not be limited to the following:

- a) Services and Equipment as per “Electrical Scope between BHEL and Vendor”.
- b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The bidder without any extra charge shall provide the same.
- c) Supply of mandatory spares as specified in the specifications of mechanical equipments.
- d) Electrical load requirement for ~~DM/ Pre Treatment and~~ Effluent Treatment Plant.
- e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer / BHEL approval without any commercial and delivery implications to BHEL.
- g) Various drawings including GA drg, data sheet as per required format, quality plans, calculations, test reports, test certificates, operation and maintenance manuals, characteristic curves, wiring diagrams/schemes etc. shall be furnished as specified at contract stage. All documents shall be subject to customer / BHEL approval without any commercial implications to BHEL.
- h) The sub-vendor list for various electrical items is subject to BHEL/Customer approval without any commercial implications.
- i) Motors shall meet minimum requirement of Electric motor specification.
- j) All routine tests and type tests reports as per applicable standards shall be furnished at contract stage.
- k) Purchaser will furnish data sheets to the vendor after award of contract. Vendor shall furnish filled in data sheets meeting the specification requirements.
- l) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
- m) Cable BOQ worked out based on routing of cable listing provided by the vendor for “both end equipment in vendor's scope” shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer “Electrical Scope between BHEL and Vendor”.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- 3.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical / quality assurance requirements stipulated. In line with this, the bidder as technical offer shall furnish two signed and stamped copies of the following:
 - a) If there is any conflict, customer motor specification will prevail over BHEL motor specification.
- 3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

	TITLE: ELECTRICAL EQUIPMENT SPECIFICATION FOR EFFLUENT TREATMENT 1 X 800MW WANABORI TPS	SPECIFICATION NO. PE-TS-408-164-A001
		VOLUME NO. : II-B
		SECTION: C
		REV NO. : 00 DATE: 08/04/2015
		SHEET: 1 OF 1

4.0 LIST OF ENCLOSURES

- 4.1 Electrical scope between BHEL & vendor
- 4.2 Technical specification – Specification for Electric Motors/Actuators
- 4.3 Datasheets & quality plan for motors.
- 4.4 Load Data Format. (Annexure –II)
- 4.5 BHEL Cable listing format (Annexure –III)

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGES: EFFLUENT TREATMENT

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 1X800 MW WANABORI TPS

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	BHEL BHEL BHEL	BHEL Vendor BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, optical fibre etc.	Vendor	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
6	Cable trays, accessories & cable trays supporting system 100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling	BHEL Vendor	BHEL Vendor	Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage.
7	Cable glands ,lugs and bimetallic strip for equipment supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power and control cables.
8	Conduit and conduit accessories for cabling between equipment supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
9	Lighting	BHEL	BHEL	
10	Equipment grounding (including electronic earthing) & lightning protection	BHEL	BHEL	Refer note no. 4 for electronic earthing
11	Below grade grounding	BHEL	BHEL	

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGES: EFFLUENT TREATMENT

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 1X800 MW WANABORI TPS

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
12	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
15	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
16	a) Input cable schedules (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Electrical Equipment & cable tray layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish Electrical equipment layout & cable tray layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Cabling arrangement of the same (wherever overhead cable trays, trenches, cable ducts, conduits etc.) shall be decided during contract stage. Electrical equipment layout & cable tray layout drawing shall be subjected to BHEL/ customer approval without any commercial implications to BHEL.
18	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.
4. Vendor shall indicate location of Electronic Earth pit in their Civil assignment drawing.

[illegible]

VOLUME : IIF/1

SECTION-II

**TECHNICAL SPECIFICATION
FOR
A.C. & D.C. MOTORS**

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	STANDARDS
3.00.00	SERVICE CONDITIONS
4.00.00	TYPE AND RATING
5.00.00	PERFORMANCE
6.00.00	SPECIFIC REQUIREMENTS
7.00.00	ACCESSORIES
8.00.00	TESTS
9.00.00	DRAWINGS, DATA & MANUALS

ATTACHMENT

ANNEXURE-A	DESIGN DATA
------------	-------------

VOLUME : IIF/1

SECTION-II

**TECHNICAL SPECIFICATION
FOR
A.C. & D.C. MOTORS**

1.00.00 SCOPE

- 1.01.00 This section covers the general requirements of the drive motors for power station auxiliary equipment.
- 1.02.00 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.
- 1.03.00 In case of any discrepancy, the driven equipment specification shall govern.

2.00.00 STANDARDS

- 2.01.00 All motors shall conform to the latest applicable IS, IEC and CBIP Standards/ Publications except when otherwise stated herein or in the driven equipment specification.
- 2.02.00 Major standards, which shall be followed, are listed below other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed :
- IS-325
- IS-12615
- IEC-34

3.00.00 SERVICE CONDITIONS

- 3.01.00 The motors will be installed in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.
- 3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.
- 3.03.00 For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 TYPE AND RATING

4.01.00 A.C. Motors

4.01.01 Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type.

4.01.02 All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.

4.01.03 The motor name-plate rating at 50°C shall have at least 10% margin over the input power requirement of the driven HT equipment and 15% for LT driven equipment at rated duty point unless stated otherwise in driven equipment specification or in general electrical specification.

4.01.04 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service.

4.01.05 All HT & LT motors shall be energy efficient type as per IS. However for HT motors, if the same is not specified in IS, minimum efficiency of all HT motors shall be considered as 90%.

4.02.00 D.C. Motors

4.02.01 D.C. motor provided for emergency service shall be shunt/compound wound type. All DC motors shall be energy efficient type with minimum efficiency of 80%.

4.02.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability.

Starter panel complete with all accessories shall be included in the scope of supply.

5.00.00 PERFORMANCE

5.01.00 Running Requirements

5.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure

5.01.02 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.

5.01.03 The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.

5.02.00 Starting Requirements

Motor shall be designed for direct online starting at full voltage. Starting current shall not exceed 6 times full load current for all HT motors except boiler feed pump motor where the starting current shall be limited to 4.5 times. No further tolerances are applicable on starting current specified above

for HT motors. For LT motors, the applicable starting current shall be limited to 7.2 times of full load current including all tolerance.

5.02.01 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.

5.02.02 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminal except BFP motor. In case of BFP motor, it shall be 80% rated voltage. Minimum starting requirement for mill motor (double cage) shall be 80% rated voltage at motor terminals. However for mill motors if the minimum starting voltage is more than 80% rated voltage at motor terminal and within 90% rated voltage, bidder shall provide necessary arrangement to keep the motor terminal voltage above that voltage to achieve smooth start of the motor.

5.02.03 a) Motor shall be capable of three equally spread starts per hour, two starts in quick succession from cold condition and one restart from hot condition.

b) Cranking motor shall be capable of six equally spread starts per hour, three starts in quick succession from cold condition and one restart from hot condition. The coal conveyor and crusher motors shall be suitable for 3 consecutive hot starts with maximum 20 starts per day.

c) Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with shaft rotating at 125% rated speed in reverse direction.

5.02.04 HT pump motors shall be suitable to start with forward rotation.

5.02.05 The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage

5.03.00 **Stress During Bus Transfer**

5.03.01 The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.

5.03.02 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.

5.04.00 **Locked Rotor Withstand Time**

5.04.01 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 2.5 seconds for motors up to 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time.

5.04.02 Starting time mentioned above is at minimum permissible voltage of 80% rated voltage.

5.04.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.

6.00.00 SPECIFIC REQUIREMENTS

6.01.00 Enclosure

6.01.01 All motor enclosures for outdoor, semi-outdoor & indoor application shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction with canopy.

6.01.02 Motors for circulating water pumps of large output ratings, located indoor and not directly exposed to coal dust or fly ash, could have screen protected drip proof enclosure conforming to IP-23.

6.01.03 For hazardous area approved type of increased safety enclosure shall be furnished.

6.02.00 Cooling

6.02.01 The motor shall be self ventilated type, either totally enclosed fan cooled (TEFC) or closed air circuit air- cooled (CACA) or totally enclosed tube ventilated (TETV) type. Totally enclosed tube ventilated (TETV) type motors shall be acceptable for HT motors only.

6.02.02 For large capacity motors, closed air circuit water cooled (CACW) may be considered for acceptance.

6.03.00 Winding and Insulation

6.03.01 All insulated winding shall be of copper.

6.03.02 All motors shall have class F insulation but limited to class B temperature rise.

6.03.03 Windings shall be impregnated to make them non-hygroscopic and oil resistant.

6.04.00 Tropical Protection

6.04.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

6.04.02 All fittings and hardware shall be corrosion resistant.

6.05.00 Bearings

6.05.01 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application.

6.05.02 Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred.

6.05.03 Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.

6.05.04 Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves.

- 6.05.05 Grease lubricated bearings shall be prelubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication.
- 6.05.06 Oiled bearing shall have an integral self cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs.
- 6.05.07 Forced lubricated or water cooled bearing shall not be used without prior approval of Owner.
- 6.05.08 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent.
- 6.05.09 Bearings shall be insulated as required to prevent shaft current and resultant bearing damage.
- 6.06.00 **Noise & Vibration**
- 6.06.01 The noise level shall not exceed 85db (A) at 1.5 metres from the motor at no load condition.
- 6.06.02 The peak amplitude of the vibration shall be within IS/IEC specified limits.
- 6.07.00 **Motor Terminal Box**
- 6.07.01 HT Motor terminal box (Phase side) shall be Phase Segregated (PSTB) type and LT motor terminal box shall be non-phase segregated type. Both HT & LT motor terminal box shall be located in accordance with Indian Standards clearing the motor base- plate/ foundation.
- 6.07.02 Terminal box shall be capable of being turned 360 Deg. in steps of 180 Deg. for HT motors and 90 Deg. for LT motors unless otherwise approved.
- 6.07.03 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor.
- 6.07.04 The terminal box shall have sufficient space inside for termination/connection of XLPE insulated armoured aluminium cables.
- 6.07.05 Motor main terminal box shall be located right hand side of motor body looking from driving end.
- 6.07.06 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.
- 6.07.07 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.
- 6.07.08 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.
- 6.07.09 HT motor phase side terminal box shall be phase-segregated type and HT motor neutral leads shall be brought out in a separate terminal box preferably

opposite side of phase terminal box & may not be necessarily phase segregated type with shorting links for star connection.

6.07.10 Motor terminal box shall be furnished with suitable cable lugs and nickel plated double compression brass glands to match with cable used.

6.07.11 The gland plate for single core cable shall be non-magnetic type.

6.08.00 Grounding

6.08.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

6.08.02 The grounding connection shall be suitable for accommodation of ground conductors as follows :

HT Motor (11kV, 6.6kV & 3.3 kV) : 75 X 10 mm GS Flat

LT Motor above 90 KW : 50 x 6 mm GS Flat

Motor above 30 KW up to 90 KW : 35 x 6 mm GS Flat

Motor above 5 KW up to 30 KW : 25 x 3 mm GS Flat

Motor up to 5 KW : 8 SWG GI Wire

6.08.03 The cable terminal box shall have a separate grounding pad.

6.09.00 Rating Plate

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate :

- a) Temperature rise in Deg.C under rated condition and method of measurement.
- b) Degree of protection.
- c) Bearing identification no. and recommended lubricant.
- d) Location of insulated bearings.

7.00.00 ACCESSORIES

7.01.00 General

Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application.

7.02.00 Space Heater

7.02.01 Motor of rating 30 KW and above shall be provided with space heaters, suitably located for easy removal or replacement.

- 7.02.02 The space heater shall be rated 240 V, 1 phase 50 Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.
- 7.03.00 **Temperature Detectors**
- 7.03.01 All 11000V, 6600V and 3300V motors shall be provided with twelve (12) nos. simplex type winding temperature detectors, four (4) nos. per phase. Six (6) nos. duplex type winding temperature detectors, two (2) nos. per phase shall only be acceptable for special application motors only subject to approval of owner.
- 7.03.02 11000V, 6600V and 3300V motor bearing shall be provided with duplex type temperature detectors.
- 7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C.
- 7.03.04 Leads of all simplex type motor winding RTDS and motor bearing RTDS shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDS will be connected to numerical protection relay and another set shall be kept free for DCS connectivity.
- 7.03.05 Five numbers of Temperature detectors / thermistors shall be provided for L.T. motors above 90 KW (3 nos. winding temperatures & 2 nos. bearing temperatures)
- 7.04.00 **Indicator/Switch**
- 7.04.01 Dial type local indicator with alarm contacts shall be provided for the following:
- a) 11000 V, 6600V and 3300V motor bearing temperature.
 - b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor.
- 7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used.
- 7.04.03 Alarm switch contact rating shall be minimum 0.5 A at 220V D.C. and 5A at 240V A.C.
- 7.05.00 **Current Transformer for Differential Protection**
- 7.05.01 Motor 1000 KW and above shall be provided with three differential current transformers mounted over the neutral leads within the enclosure. Loose 3 nos. CT for mounting on switchgear side shall be in bidder's scope.
- 7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match Owner's requirements to be intimated later.
- 7.06.00 **Accessory Terminal Box**

7.06.01 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.

7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit cable connections.

7.07.00 Drain Plug

Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

7.08.00 Lifting Provisions

Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.

7.09.00 Dowel Pins

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

7.10.00 Painting

Motor including fan shall be painted with corrosion proof paints of colour battle ship grey shade 632 of IS-5.

8.00.00 TESTS

Routine and Type Tests are to be conducted in presence of customer's representative as per IS:325 and required copies of test certificates are to be furnished for approval. In addition, following tests shall have to be carried out on the motors in presence of OWNER's representative on 3.3kV/6.6kV/11kV motors.

- a. Impulse test by 1.2 / 50 micro sec. On sample coil of Stator winding insulation as type test as per IEC-60034, part -15 test voltages as under :

Voltage rating of motor	Impulse Test Voltage
3.3 kV	18 kV peak
6.6 kV	31 kV peak
11 kV	49 kV peak

- b. Tan delta, charging current and dielectric loss measurements on each phase of motor stator winding as routine test.
- c. Polarization Index Test as per IS:7816 as routine test
- d. Test for suitability of IPW– 55 (Weather proof) as per IS 4691 as type test. Type test certificate for first numeral shall be acceptable in lieu of test, provided the test motor is identical to motor being supplied.

Second numeral test shall be carried out on one motor of each type and rating.

- e. Fault Withstand Test for main terminal box as type test. Type test certificate shall be acceptable, if the test is conducted on exactly identical terminal box.
- f. Test for noise level as routine test.
- g. Test for vibration as routine test.
- h. Tan delta measurement on coils.
- i. Surge withstand test for inter turn insulation.

Tests indicated at (h), (i), shall be carried out during manufacture of the coils and shall be furnished for verification.

Furnished type test certificates of motor shall not be older than five (5) years from the date of Inspection, otherwise type test shall be conducted without any price implication.

9.00.00 DRAWINGS, DATA & MANUALS

Drawings, data & manuals for the motors shall be submitted as indicated below:

9.01.00 Along with the bid

- a) List of the motors
- b) Individual motor data sheet as per format of the proposal data sheets.
- c) Scheme & write up on forced lubrication system, if any
- d) Type test report

9.02.00 After Award of the Contract

- a) Dimensional General Arrangement drawing
- b) Foundation Plan & Loading
- c) Cable end box details
- d) Space requirement for rotor removal
- e) Thermal withstand curves hot & cold
- f) Starting and speed torque characteristics at 80% & 100% voltage
- g) Complete motor data
- h) Erection & Maintenance Manual

- i) Test reports
- j) Data sheets to be enclosed

**ANNEXURE-A
DESIGN DATA**

1.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
H.T. Supply	11000 V, 3Ø, 3W, 50 Hz, non-effectively earthed	Motors above 2000 KW & all mill motors
	Fault level 44 KA symm.	
	3300 V, 3Ø, 3W, 50 Hz, non-effectively earthed	Motors above 160 KW upto and including 2000 KW
	6600 V, 3Ø, 3W, 50 Hz, non-effectively earthed	Motors of CHP system and Water System above 160kW
	Fault level 40 KA symm for 3300V & 6600V	
L.T. Supply	415V, 3Ø, 3W, 50 Hz effectively earthed	Motors upto and including 160KW
	Fault level 50 KA symm.	
	240V, 1Ø, 2W, 50 Hz effectively earthed	Lighting, space heating, A.C. control & protective devices
D.C. Supply	220V, 2W, unearthed	D.C. alarm, control & protective devices
	Fault level 25* KA.	

* Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation.

2.0 RANGE OF VARIATION

A.C. Supply :

Voltage : $\pm 10\%$ Frequency : $\pm 5\%$ Combined Volt : 10% (absolute sum) + frequency

During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.

D.C. Supply :

Voltage : 187 to 242 Volt



TITLE

LV MOTORS

DATA SHEET-A

SPECIFICATION NO.

VOLUME II B

SECTION D

REV NO. 00 DATE 08.04.2015

SHEET 1 OF 1

- | | | | |
|------|--|---|---|
| 1.0 | Design ambient temperature | : | 50 °C |
| 2.0 | Maximum acceptable kW rating of LV motor | : | upto 160KW |
| 3.0 | Installation (Indoors/ Outdoors) | : | As required |
| 4.0 | Degree Of Protection (Indoor/Outdoor) | : | IP54/IP55 |
| 5.0 | Type of Cooling | : | TEFC/CACA |
| 6.0 | Details of supply system | | |
| | a) Rated voltage (with variation) | : | 415V $\pm$ 10% |
| | b) Rated frequency (with variation) | : | 50 Hz $\pm$ 5% |
| | c) Combined voltage & freq. variation | : | 10% (absolute sum) |
| | d) System fault level at rated voltage | : | 50 kA for 1 sec |
| | e) Short time rating for terminal boxes | | |
| | o Above 110kW | : | 50 kA for 1 sec |
| | (Breaker controlled) | | |
| | o Upto 110kW | : | 50 KA for 0.25 sec. |
| | (Contactor controlled) | | |
| | f) LV System grounding | : | Solidly |
| 7.0 | Class of insulation | : | Class 'F' with temp rise limited to class B |
| 8.0 | Minimum voltage for starting
(As percentage of rated voltage) | : | 80% of rated voltage |
| 9.0 | Power cables data | : | Shall be given during Detailed engg. |
| 10.0 | Earth Conductor Size & Material | : | Shall be given during Detailed engg. |
| 11.0 | Space heater supply | : | 240 V, 1 Φ , 50 Hz |
| 12.0 | Rating up to which Single phase motor | : | Acceptable upto 0.20 kW |
| 13.0 | Tests | : | As per Customer motor spec.(enclosed) |
| 14.0 | Energy efficient/ Flame proof motor | : | As per Customer spec. requirement |
| 14.0 | Makes | : | AS PER ANNEXURE-I |

NOTE :

1. Also detail Customer spec. for Motors is to be referred as enclosed with technical spec.

	TITLE LV MOTOR DATA SHEET - C	SPECIFICATION NO.
		VOLUME II B
		SECTION D
		REV NO. 00 DATE
		SHEET 1 OF 2

S. No.	Description		Data to be filled by successful bidder
A.	General		
1	Manufacturer & country of origin		
2	Motor type		
3	Type of starting		
4	Name of the equipment driven by motor & Quantity		
5	Maximum Power requirement of driven equipment		
6	Rated speed of Driven Equipment		
7	Design ambient temperature		
B.	Design and Performance Data		
1	Frame size & type designation		
2	Type of duty		
3	Rated Voltage		
4	Permissible variation for		
5	a	Voltage	
6	b	Frequency	
7	c	Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)		
9	Synchronous speed & Rated slip		
10	Minimum permissible starting voltage		
11	Starting time in sec with mechanism coupled		
12	a) At rated voltage		
13	b) At min starting voltage		
14	Locked rotor current as percentage of FLC (including IS tolerance)		
15	Torque		
	a) Starting		
	b) Maximum		
16	Permissible temp rise at rated output over ambient temp & method		
17	Noise level at 1.0 m (dB		
18	Amplitude of vibration		
19	Efficiency & P.F. at rated voltage & frequency		
	a) At 100% load		
	c) At 75% load		

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	TITLE LV MOTOR DATA SHEET - C	SPECIFICATION NO.
		VOLUME II B
		SECTION D
		REV NO. 00 DATE
		SHEET 2 OF 2

S. No.	Description	Data to be filled by successful bidder
	c) At starting	
C.	Constructional Features	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level (kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
D.	Characteristic curves/ drawings (To be enclosed for motors of rating $\geq 55\text{KW}$)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

		QUALITY PLAN		CUSTOMER : TSPGCL		PROJECT : 1 X 800 MW WANABORI TPS		SPECIFICATION :				
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01		NUMBER :				
		SHEET 1 OF 2		SYSTEM		ITEM : AC ELECT. MOTORS BELOW 55KW (LV)		SPECIFICATION TITLE			SECTION : VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1		NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									

	QUALITY PLAN		CUSTOMER TSPGCL			PROJECT 1 X 800 MW WANABORI TPS			SPECIFICATION :			
			BIDDER/ :			TITLE			NUMBER :			
	SHEET 2 OF 2		VENDOR			QUALITY PLAN			SPECIFICATION :			
		SYSTEM			NUMBER PED-506-00-Q-006, REV-01			TITLE :				
					ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	
NOTES: 1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON 2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. 3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY												
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER TSPGCL		PROJECT 1 X 800 MW WANAKBORI TPS		SPECIFICATION :				
				BIDDER/ :		TITLE		NUMBER :				
		SHEET 1 OF 9		VENDOR :		QUALITY PLAN		SPECIFICATION :				
		SYSTEM		NUMBER PED-506-00-Q-007, REV-03		TITLE			SECTION VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	RAW MATERIAL & BOUGHT OUT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVANT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVANT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER TSPGCL		PROJECT 1 X 800 MW WANAKBORI TPS		SPECIFICATION :				
				BIDDER/ :		TITLE		NUMBER :				
				VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION :				
SHEET 2 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION			VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	2	
		4.INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	
1.6	SPACE HEATERS, CONNCTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2	FOR DIA OF 55 MM & ABOVE
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	2	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	2	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE					BIDDER'S/VENDORS COMPANY SEAL				

		QUALITY PLAN		CUSTOMER TSPGCL		PROJECT 1 X 800 MW WANAKBORI TPS			SPECIFICATION :			
				BIDDER/ : VENDOR		TITLE			NUMBER :			
		SHEET 3 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SPECIFICATION : TITLE			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	3	-	2	FOR MV MOTOR INSULATION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT * MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	MANUF'S SPEC.	MANUF'S SPEC.	LOG BOOK AND OR SUPPLIER'S TC	3	-	2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG. .	MANUFR'S DRG.	-DO-	3	-	2	
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	RELEVANT IS	SUPPLIER'S TC	3	-	2	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3*	-	2*	
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER : TSPGCL		PROJECT : 1 X 800 MW WANAKBORI TPS		SPECIFICATION : NUMBER :				
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE				
		SHEET 4 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.10	BEARINGS	3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
		1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	3	-	2	
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN				CUSTOMER TSPGCL			PROJECT 1 X 800 MW WANAKBORI TPS			SPECIFICATION :		
						BIDDER/ :			TITLE			NUMBER :		
		SHEET 5 OF 9				VENDOR			QUALITY PLAN			SPECIFICATION :		
					SYSTEM			NUMBER PED-506-00-Q-007, REV-03			TITLE			
					ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS		
									P	W	V			
1	2	3	4	5	6	7	8	9	10			11		
2.0	IN PROCESS													
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-			
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-			
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-			
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-			
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVANT SPEC./ ASTM-E165	MANUF'S SPEC./ BHEL SPEC./	-DO-	2	-	1			
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-			
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-			
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-			
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-			
BHEL			PARTICULARS			BIDDER/VENDOR								
			NAME											
			SIGNATURE											
			DATE						BIDDER'S/VENDORS COMPANY SEAL					

		QUALITY PLAN		CUSTOMER TSPGCL		PROJECT 1 X 800 MW WANAKBORI TPS		SPECIFICATION :					
				BIDDER/ :		TITLE		NUMBER :					
		SHEET 6 OF 9		VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE		SECTION VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	10	P	W	V	11
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-		(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-		
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1		
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-		
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-		
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1		
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-		
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-		FOR MV MOTOR
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-		
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		
BHEL			PARTICULARS			BIDDER/VENDOR							
			NAME										
			SIGNATURE										
			DATE						BIDDER'S/VENDORS COMPANY SEAL				

		QUALITY PLAN		CUSTOMER TSPGCL		PROJECT 1 X 800 MW WANAKBORI TPS			SPECIFICATION :			
				BIDDER/ :		TITLE			NUMBER :			
				VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
SHEET 7 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	VERIFICATION FOR MV MOTOR ONLY
2.8	BRAZING/COMPRESSION JOINT	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-	
2.9	COMPLETE ROTOR ASSEMBLY	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1	
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1	
2.10	ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1	
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2		1	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE		BIDDER'S/VENDORS COMPANY SEAL							

		QUALITY PLAN				CUSTOMER : TSPGCL			PROJECT : 1 X 800 MW WANAKBORI TPS			SPECIFICATION : NUMBER :		
						BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE		
		SHEET 8 OF 9				SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS		
1	2	3	4	5	6	7	8	9	10			11		
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1		
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2		
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1\$	1	\$ NOTE - 2		
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-			
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3		
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2		
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2		
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1\$	1	\$ NOTE - 2		
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3		
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1\$	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY \$ NOTE - 2		
BHEL			PARTICULARS			BIDDER/VENDOR			BIDDER'S/VENDORS COMPANY SEAL Page 289 of 531					
			NAME											
			SIGNATURE											
			DATE											

		QUALITY PLAN		CUSTOMER TSPGCL		PROJECT 1 X 800 MW WANAKBORI TPS		SPECIFICATION :			
				BIDDER/ :		TITLE		NUMBER :			
				VENDOR		QUALITY PLAN		SPECIFICATION :			
SHEET 9 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION			VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY		
									P	W	V
1	2	3	4	5	6	7	8	9	10		11
NOTES: 1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED. 2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON. 3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED. 4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY											
BHEL			PARTICULARS			BIDDER/VENDOR					
			NAME								
			SIGNATURE								
			DATE								
									BIDDER'S/VENDORS COMPANY SEAL		



**1x800 MW WANAKBORI STPP
TECHNICAL SPECIFICATION FOR
EFFLUENT TREATMENT PLANT**

SPECIFICATION No: PE-TS-408-164-A001

VOLUME: II B

SECTION : C-4

REV. 00

DATE:

**SECTION: C-4
TECHNICAL SPECIFICATION (C&I PORTION)**



**1x800 MW WANAKBORI STPP
TECHNICAL SPECIFICATION FOR
EFFLUENT TREATMENT PLANT**

SPECIFICATION No: PE-TS-408-164-A001

VOLUME: II B

SECTION : C-4

REV. 00

DATE:

1. SCOPE OF SUPPLY

Instrumentation (Minimum) as shown in the flow diagram, however any additional instrumentation required to complete the system will be in bidder's scope. All required piping, tubing and wiring for instrumentation including fittings, support and other accessories.

Control panels required for equipment such as HRSCC.

2. CONTROLS:

The control concept for Effluent Treatment System shall be such that the operation of the total Treatment System can be monitored and controlled from Local Control Panels (relay based hardware) as described hereinafter. The panels shall be used for mounting instruments, annunciators etc.

The Control Panels Shall be provided are as follows:

- One (1) no. LCP Shall be provided in ETP Chemical house to control all the drive located at ETP area [acid dosing system, alkali dosing system, guard pond, dosing pumps, transfer pumps, flash mixer, ISS, OWS, etc].
- One (1) no. LCP shall be provided near Boiler wash water collection sump.
- One (1) no. LCP shall be provided near TG area wash water collection sump.
- One (1) no. LCP shall be provided near Oily waste from Power house TG area waste water collection sump.
- One (1) no. LCP shall be provided near Oily waste from Power house SG area waste water collection sump.
- One (1) no. LCP shall be provided near Fuel Oil Dyke area near Retention pit-1.
- One (1) no. LCP shall be provided near Transformer Year Oily waste area.
- One (1) no. LCP shall be provided near Side Stream Filtration plant back wash collection pit.

1.1.1 All pumps and agitators shall trip at level low in respective tanks/pits and start when level is low.

1.1.2 Online flow indicator shall be provided in each effluent water sources.

At discharge of clear water transfer pump online pH meter, TDS meter, Turbidity, Temperature and Flow meter shall be provided to check the final discharge water quality. A CCTV camera shall be provided at clear water reservoir for online recording.

All panel located out door shall be protected with suitable canopy is in bidder scope.



**1x800 MW WANAKBORI STPP
TECHNICAL SPECIFICATION FOR
EFFLUENT TREATMENT PLANT**

SPECIFICATION No: PE-TS-408-164-A001

VOLUME: II B

SECTION : D

REV. 00

DATE:

**SECTION: D
STANDARD TECHNICAL SPECIFICATIONS**

	TITLE: 1x800 MW WANAKBORI STPP TECHNICAL SPECIFICATION FOR EFFLUENT TREATMENT PLANT	SPEC NO: PE-TS-408-164-A001	
		VOLUME: II-B	
		SECTION: D1	
		REV NO: 00	DATE:

SECTION-D1

(GENERAL TECHNICAL REQUIREMENT FOR MECHANICAL)

	TITLE: 1x800 MW WANAKBORI STPP TECHNICAL SPECIFICATION FOR EFFLUENT TREATMENT PLANT	SPEC NO: PE-TS-408-164-A001	
		VOLUME: II-B	
		SECTION: D1	
		REV NO: 00	DATE:

1.0 SYSTEM DESCRIPTION FOR EFFLUENT TREATMENT PLANT (Ref. Drg. no. PE-DG- 408-164-A001)

The Effluent treatment plant (ETP) has been provided to remove total suspended solids and oil from waste water. The treated water and generated sludge shall be utilized inside the plant boundary itself in different areas like gardening, Coal handling plant (for dust suppression) and Ash handling plant.

Following effluents will be collected /treated in the Effluent treatment plant (ETP):

- Regeneration waste from DM plant.
- Backwash waste of PSF and ACF for DM Plant (**pumping and transferring shall be taken care in DM Plant Package, Refer Drg No: PE-DC-408-163-A001**).
- Condensate Polishing Unit regeneration waste (**pumping and transferring shall be taken care in CPU Package Refer Drg No: PE-DC-408-155A-A001**).
- Cooling Tower Blow Down.
- Boiler /TG Area Wash Water.
- Oily waste from Power house area (TG and SG).
- Oily waste from Fuel oil Dyke area.
- Transformer Yard oily waste.
- Backwash Waste Water from Side Stream Filtration.
- Guard pond and Clear water Reservoir.
- Coal pile runoff waste treatment/handling (**Shall be taken care by coal handling package**).
- Boiler blow down [**Being a super critical plant boiler blow down is not applicable and any boiler drain shall be recycled back to system by BHEL, hence, not coming to ETP**].

Brief description is mentioned below:

a) Regeneration waste from DM plant.

DM Plant Regeneration Waste will be generated due to periodic regeneration of resin-beds by acid or alkali. It will contain high amount of dissolved solids and also may be acidic or alkaline based on sequence of the regeneration. The regeneration waste comprising of acid, alkali and backwash water from the DM plant is led to the Neutralization Pit through drain channels. The pH of neutralized waste is maintained in the range of 7.2-8.0 by dosing acid/alkali in N-pit in DM plant area.

Once the pH level in the waste is achieved within desirable range the same is pumped to the Guard Pond by means of Neutralized Waste Disposal Pumps (DM plant scope). As the treatment of regeneration waste of DM Plant is carried out in DM Plant itself, no further treatment scheme for control of pH has been envisaged. All the pumps, N-pit, Acid & Alkali dosing system, piping etc. shall be under DM plant scope (by BHEL).

b) Backwash waste of PSF and ACF for DM Plant.

Shall be taken care in DM Plant Package.

c) Condensate Polishing Unit (CPU) regeneration area regeneration waste.

The regeneration waste from Condensate Polishing Plant regeneration area shall be collected in neutralization pit to be constructed under CPU regeneration area. This regeneration waste will contain high amount of dissolved solids and also may be acidic or alkaline based on sequence of the regeneration. The regeneration waste is led to the Neutralization Pit through drain channels. The pH of neutralized waste is maintained in the range of 7.2-8.0 by dosing acid/alkali in N-pit in Condensate Polishing Unit regeneration area.

Once the pH level in the waste is achieved within desirable range the same is pumped to the Guard Pond by means of Neutralized Waste Disposal Pumps (CPU plant scope). As the treatment of regeneration waste of CPU Plant is carried out in CPU Plant itself, no further treatment scheme for control of pH has been envisaged. All the pumps, N-pit, Acid & Alkali dosing system, piping etc. shall be under CPU plant scope (by BHEL).

d) Cooling Tower Blow Down

Cooling Tower Blow Down (CTBD) is done to maintain the level of dissolved solids in the Circulating Cooling Water. This effluent will contain dissolved solids and chemicals/biocides used for prevention of scale formation

	TITLE: 1x800 MW WANAKBORI STPP TECHNICAL SPECIFICATION FOR EFFLUENT TREATMENT PLANT	SPEC NO: PE-TS-408-164-A001	
		VOLUME: II-B	
		SECTION: D1	
		REV NO: 00	DATE:

/corrosion / bio fouling. The CTBD is collected in Guard Pond (Compartmetn-1) for further use to CHP Dust Suppression by using CHP Dust Suppression Pumps. (Ref WBD: PE-DG-408-172-N009).

e) Boiler /TG Area Wash Water

Boiler /TG Area Wash Water is generated from floor washings, leakages from bearing cooling systems, leakage from pumps etc. This waste basically contains suspended solids. An underground Retention Pit shall be provided to collect the waste from Boiler /TG Area. From Retention Pit, the waste shall be transferred by Pumps to Guard Pond for equalization.

f) Oily waste from Power house area (TG and SG).

Power House area (TG area and SG area) oily waste is generated from oil leakage from oil burners etc. This effluent basically contains suspended solids and some oil and grease. An underground Retention Pit shall be provided to collect oily waste from Power House area (TG area and SG area). From Retention Pit, the waste shall be transferred by Pumps to Pre Oil Water Separator Collection Pit located at ETP area for further treatment.

g) Oily waste from Fuel Oil Dyke Area.

The oily waste run off during regular washing/cleaning, leakage and draining from Fuel Oil Dyke area shall be treated in Oily Waste Treatment System. An underground Retention Pit shall be provided to collect run off water followed by an OWS [OWS shall be supplied by Fuel Oil handling supplier (BHEL)]. Oily waste from that OWS shall be recycled to the Fuel oil tank and clear water (Oil 1000 ppm) from OWS shall be collected in Retention pit-1 located near OWS. From retention pit-1 the water with oil shall be pumped to Pre oil water separator retention pit located at ETP for further treatment.

h) Transformer Yard oily waste.

The oily waste from transformer yard (in case of fire) shall be collected in a retention pit near transformer area and the same shall be further pumped to pre oil water separator pit located at ETP for further treatment.

From the Pre Oil Water Separator Collection Pit the oil contaminated effluent shall be pumped to Oil Water Separator (Corrugated Plate Interceptor for removal of oil and suspended solids. Separated oil shall be collected in a Slop Oil Storage Tank. The treated water from OWS shall collected in another collection pit from where treated water shall be pumped to Guard Pond.

Sludge produced from CPI will be collected in a pit and then transferred by means of CPI Sludge Transfer Pumps for land filling purpose.

i) Backwash Waste Water from Side Stream Filtration

Backwash waste from Side Stream Filters will be collected in a pit and then Pumped by means of Backwash Water Transfer Pumps to inlet of Inclined Surface Settler (ISS) for further sludge removal by help of alum dosing.

The clear water from Inclined Surface Settler shall be collected in Clear Water Reservoir for further use in gardening and ash handling plant.

The Sludge from ISS and CPI (through CPI sludge pit) shall be collected in sludge sump for further use in ash handling system (approx. 2% sludge consistency).

Sizing Calculation of Side Stream Filtration Backwash pit

Velocity criteria of Backwash = 2.5 times of inlet velocity.

Capacity of one AVGF = 250 M³/Hr.

	TITLE: 1x800 MW WANAKBORI STPP TECHNICAL SPECIFICATION FOR EFFLUENT TREATMENT PLANT	SPEC NO: PE-TS-408-164-A001	
		VOLUME: II-B	
		SECTION: D1	
		REV NO: 00	DATE:

Backwash cycle happens for 6 mints (typ.) per AVGF.

Accordingly maximum back wash water generated per AVGF = $250 \times 2.5 \times 6 / 60 = 62.5$ M3.

Maximum back wash water generated for two AVGF = $62.5 \times 2 = 125$ M3.

Capacity of back wash pit selected = 150 M3.

j) Guard Pond Waste Treatment & Recycling System

Waste water from cooling tower blow down, DM Plant and CPU regeneration waste collected in Guard pond shall be pumped to ISS for further sludge removal.

The ISS is accompanied with Flash Mixers and Flocculation Tanks. From Flocculation Tanks water will then flow to ISS. Alum solution will be added to water.

k) Design philosophy for Lamella Clarifier:

Normally, all three (3) Flash Mixers, three (3) Flocculation Tanks and three (3) Inclined Surface Settlers will operate in under-load condition. However, in case anyone hook-up, consisting of Flash Mixer, Flocculation Tank or Inclined Surface Settler is taken out for maintenance, the other two streams with 20 % overload will be able to cater for the total water requirement.

The treated water from Inclined Surface Settlers shall be stored in a Clear Water Reservoir. From the reservoir water shall be distributed to Ash handling plant and Gardening (Horticulture). Sludge generated from Oil Water Separator shall be directed to CPI Sludge Pit for further transfer to Incline Surface Settler Sludge Sump along with sludge from Inclined Surface Settler. The sludge shall from Inclined Surface Settler Sludge Sump is finally pumped to Ash Handling Plant.

Two (2) nos. Air Blowers shall be provided for the sludge sump for proper agitation.

- l) A Chemical House shall be provided to handling, storage, solution preparation and injection of chemicals for treatment of waste water and control the ETP.

	TITLE: 1x800 MW WANAKBORI STPP TECHNICAL SPECIFICATION FOR EFFLUENT TREATMENT PLANT	SPEC NO: PE-TS-408-164-A001	
		VOLUME: II-B	
		SECTION: D2	
		REV NO: 00	DATE:

SECTION-D2

(GENERAL TECHNICAL REQUIREMENT FOR ELECTRICAL)

- 1.1 GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS (NO OF SHEET=5)
- 1.2 CABLE SCHEDULE FORMAT AND CABLE DETAILS (NO OF SHEET=24)

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101 VOLUME NO. : II-B REV NO. : 00 DATE : 29/08/2005 SHEET : 1 OF 1
--	--	--

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 1 OF 4

1.0

INTENT OF SPECIFIATION

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer’s work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.

2.0

CODES AND STANDARDS

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

IS:325	Three phase Induction motors
IS : 900	Code of practice for installation and maintenance of induction motors
IS: 996	Single phase small AC and universal motors
IS: 4722	Rotating Electrical machines
IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines
IS: 4728	Terminal marking and direction of rotation rotating electrical machines
IS: 1231	Dimensions of three phase foot mounted induction motors
IS: 8789	Values of performance characteristics for three phase induction motors
IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment
IS: 2148	Flame proof enclosures for electrical appliance
IS: 5571	Guide for selection of electrical equipment for hazardous areas
IS: 12824	Type of duty and classes of rating assigned
IS: 12802	Temperature rise measurement for rotating electrical machnines
IS: 12065	Permissible limits of noise level for rotating electrical machines
IS: 12075	Mechanical vibration of rotating electrical machines

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0

DESIGN REQUIREMENTS

3.1

Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A

3.2

Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information
Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.

3.3

Starting Requirements

3.3.1

Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.3.2

Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 2 OF 4

The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.

3.3.3 The following frequency of starts shall apply

- i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.
- ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)
- iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for minimum 20,000 starts during the life time of the motor

3.4 Running Requirements

3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.

3.5 Stress During bus Transfer

3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

4.0 CONSTRUCTIONAL FEATURES

4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy

4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.

Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled

4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 3 OF 4
4.4.	Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.	
4.5	Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.	
4.6	In case Class ‘F’ insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class ‘B’ insulation. In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.	
4.7	Terminals and Terminal Boxes	
4.7.1	Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A. Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet “A”.	
4.7.2	unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.	
4.7.3	Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.	
4.7.4	Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.	
4.7.5	Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.	
4.7.6	Degree of protection for terminal boxes shall be IP 55 as per IS 4691.	
4.7.7	Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.	
4.7.8.	Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.	
4.7.9	Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.	
4.8	Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.	
4.9	General	

Page 202 of 521

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 4 OF 4
4.9.1 Motors provided for similar drives shall be interchangeable. 4.9.2 Suitable foundation bolts are to be supplied alongwith the motors. 4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above. 4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956. 4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz. 4.9.6 Name plate with all particulars as per IS: 325 shall be provided 4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions. 5.0 INSPECTION AND TESTING 5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied. 5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser. 5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan. 5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A. 6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT a) OGA drawing showing the position of terminal boxes, earthing connections etc. b) Arrangement drawing of terminal boxes. c) Characteristic curves: (To be given for motor above 55 kW unless otherwise specified in Data Sheet). i) Current vs. time at rated voltage and minimum starting voltage. ii) Speed vs. time at rated voltage and minimum starting voltage. iii) Torque vs. speed at rated voltage and minimum voltage. For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling. iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.		

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT_CAB_SCH_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
 - a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
 - b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
 - f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
 - g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

A	NN	A	NNN
Cable	No. of cores	Cable code	Cable size
Voltage	(e.g. 01,03,3H, 07)	(See C below)	(e.g. 035,185,2.5, 0.5)
Code (see B below)			

(A) SYSTEM VOLTAGE CODES:

(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V
 (dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) CABLE VOLTAGE CODES:

A = 11KV (Power cables)

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

B = 6.6KV (Power cables)
C = 3.3KV (Power cables)
D = 1.1KV (LV & DC system power & control cables)
E = 0.6KV (0.5 sq. mm. Control cables)

(C) CABLE CODES

PVC Copper

A = Armoured FRLS	B = Armoured Non-FRLS
C = unarmoured FRLS	D = Unarmoured Non-FRLS

PVC Aluminium

E = Armoured FRLS	F = Armoured Non-FRLS
G = unarmoured FRLS	H = Unarmoured Non-FRLS

XLPE Copper

J = Armoured FRLS	K = Armoured Non-FRLS
L = unarmoured FRLS	M = Unarmoured Non-FRLS

XLPE Aluminium

N = Armoured FRLS	P = Armoured Non-FRLS
Q = unarmoured FRLS	R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES
T = TOUGH RUBBER SHEATH
U = OVERALL SCREENED
V = PAIRED OVERALL SCREENED
W = PAIRED INDIVIDUAL SCREENED
Y = COMPENSATING CABLES
I = PRE-FABRICATED CABLES
Z = JELLY FILLED CABLES

ANNEXURE III

Page 306 of 531

VOLUME : IIF/2

SECTION-IV

**TECHNICAL SPECIFICATION
FOR
CABLES**

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE OF SUPPLY
2.00.00	CODES & STANDARDS
3.00.00	DESIGN CRITERIA
4.00.00	SPECIFIC REQUIREMENTS
5.00.00	TESTS
6.00.00	DRAWINGS DATA & MANUALS

ATTACHMENTS

ANNEXURE-A	RATINGS AND REQUIREMENTS - H.V POWER CABLES (11KV, 6.6KV & 3.3 KV)
ANNEXURE-B	RATINGS AND REQUIREMENTS - L.V POWER CABLES
ANNEXURE-C	RATINGS AND REQUIREMENTS - CONTROL CABLES
ANNEXURE-D	RATINGS AND REQUIREMENTS - 1.1KV FS POWER CABLE
ANNEXURE-E	RATINGS AND REQUIREMENTS - 1.1KV FS CONTROL CABLE
ANNEXURE-F	RATINGS AND REQUIREMENTS - FLEXIBLE TRAILING CABLES
ANNEXURE-G	CABLE SIZES

SECTION-IV

TECHNICAL SPECIFICATION FOR CABLES

1.00.00 SCOPE OF SUPPLY

1.01.00 Power and Control Cables shall cover the requirement of entire Plant including the switchyard. The cables shall be furnished in accordance with this specification and annexure.

Other cables including special cables if any which are necessary as per proven engineering practice for satisfactory & trouble free operation of the entire cable system of the plant shall also be within the scope of supply. These shall include all such cables for electrical integral with mechanical equipment systems and subsystems.

1.02.00 Cable shall be furnished in accordance with this specification and the following annexures :

- a) 11 kV, 6.6kV & 3.3 kV Power cables : Annexure - A
- b) 1100V Power Cables : Annexure – B
- c) Control Cables : Annexure – C
- d) Fire Survival Cables : Annexure – D & E
- e) Flexible Trailing cable : Annexure – F

1.03.00 All relevant drawings, data and instruction manuals

2.00.00 CODES & STANDARDS

2.01.00 All cable and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

2.02.00 Cable and material conforming to any other standard which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

2.03.00 The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

3.00.00 DESIGN CRITERIA

- 3.01.00 Cables will be generally laid on ladder type trays, perforated type cable trays or drawn through rigid steel conduits [Rigid steel conduits shall be used for interconnection of cables from near-by cable tray to equipment where cable tray cannot be installed as well as to prevent mechanical damage of cables for critical equipment. Moreover in dust prone area the lay out of cable tray shall be in vertical plane].
- 3.02.00 For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard and/or this specification which one is more stringent.
- 3.03.00 The insulation and sheath materials shall be resistant to oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling.
- 3.04.00 Armouring shall be single round wire of galvanized steel for multicore cables and aluminum for single core cable for power and control cables. For fire survival control cable, the armouring over inner sheath shall consist of single layer of wire / round galvanised steel wire as per IS 3975 amended upto date. For Fire survival power cable, Single core cables to be used in A.C. system, the armouring over inner sheath shall consist of single layer of round copper wire, for multi-core cables to be used in A.C. system and single/two core cables in D.C. System, the armouring over inner sheath shall consist of single layer of round galvanised steel wire.
- 3.05.00 The outer sheath shall have flame retardant low smoke halogen evolution (FRLS) characteristics or fire survival characteristics as applicable and shall meet the requirements of additional tests specified for the purpose.
- 3.06.00 Core identification for multicore cable shall be provided by colour coding.
- 3.07.00 HT cables shall be manufactured by triple extrusion dry cured (CCV) process using pressurized nitrogen.

4.00.00 SPECIFIC REQUIREMENTS

4.01.00 General Description

All Cables shall be furnished in strict compliance with ratings and requirements and sizes as given in Annexures to this Specification.

4.02.00 Drum Length and Tolerance

The cables shall be supplied in non-returnable packing steel drum for 11 kV, 6.6 kV & 3.3 kV power cables, wooden drums for 1100V power and control cables, each containing minimum 500 meters length of larger sizes of cable unless specifically asked for. For smaller sizes of cables, each drum shall contain 1000 meters length of cable. Allowable tolerance on individual drum length is $\pm 5\%$.

4.03.00 Non-Standard Length

Non-standard lengths upto 5% of the total ordered quantity may be accepted. However the Contractor will be required to obtain approval before packing the Cables on drums. Non-standard lengths shall not be less than 100 metres in any case.

4.04.00 Cable identification

Cable identification shall be provided by embossing on every meter on the outer sheath the following :

- a) GSECL
- b) Manufacturer's name or trade mark
- c) Voltage grade
- d) Year of manufacture
- e) Type of insulation, e.g. XLPE/PVC/HR85/IE2 etc.
- f) No. of core and size of cables.
- g) Type of improved fire performance, e.g. FR/FRLS/FS
- h) IS number

4.05.00 Packing

4.05.01 Cables shall be supplied in non returnable drums. The drums shall be of heavy construction. All wooden parts shall be manufactured from seasoned wood. All ferrous parts used shall be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage. Wooden cable drum shall be treated by immersing in copper-nitrate solution.

4.05.02 Cable shall be wound and packed on drums in such a manner that it will be properly sealed and firmly secured to the drum. The ends of each length shall be sealed before shipment.

4.05.03 The cable drums should carry the following details in printed form:

- a) MSPGCL
- b) Manufacturer's name or trade make
- c) Type of cable & voltage grade
- d) Year of manufacture
- e) Type of insulation e.g. XLPE/HRPVC/IE2
- f) No. of core and size of cables
- g) Cable code e.g. FRLS/FS
- h) Length of cable on drum

- i) No. of length on drum, if more than one
- j) Direction of rotation, by arrow
- k) Approx. gross mass.
- l) IS/IEC number and ISI mark

4.06.00 Joints and Terminations

Materials of construction for a joint/termination shall perfectly match with the dielectric chemical and physical characteristics of the associated cables. The material and design concepts shall incorporate a high degree of operating compatibility between the cable and joints. The protective outer covering (jacket) used on the joints/terminations shall have the same qualities as that of the cable outer sheath in terms of ambient/operating temperature withstand capability and resistance to hazardous environments and corrosive elements. Straight through joints and terminations for HT cables shall be heat shrinkable type.

4.07.00 Selection Criteria

- 4.07.01**
- a) HT and LT power cables shall be selected on the basis of current carrying capacity, short circuit rating and permissible voltage drop.
 - b) While sizing power cables, following aspects shall be reckoned:
 - i) Ground/Ambient Air temperature
 - ii) Depth of Laying.
 - iii) Power Cables touching each other.
 - c) Cables, for circuit breaker controlled feeders, shall withstand the short circuit current for the fault clearing time. 0.2 Sec.
 - d) HT cables shall be sized based on the following considerations:
 - Rated current of the equipment and ground/ambient temperature.
 - Touching/spacing of cable.
 - Depth of laying.
 - The voltage drop of the cable , during motor starting condition , shall be limited to 15% and during full load running condition shall be limited to 3 % rated voltage. Other outgoing feeder /transformer feeder shall be limited to 3% rated voltage.
 - Short circuits withstand capability
 - e) For fuse/MCCB/Breaker protected circuits the conductor size shall depend upon full load current subject to voltage drop limited to 3% during running of all feeders and 15% during starting for motor feeders. In addition, transformer regulation shall also be considered

for loads fed from 415V PMCC. In case of other outgoing line feeder voltage drop shall be limited to 3%.

- f) For loads fed from local panels, the total running voltage drop in cable from 415V PMCC to local panel and from local panel to individual motor shall be limited to 3% at full load motor current while the same during starting shall be limited to 15%.
- g) As per national electric code (NEC) current rating capacity of motor feeder/cables should be 125% of full load current.
- h) For welding receptacle, 3% running drop shall only be considered.

The minimum sizes of L.T cable to be chosen are as below:

AL - 16 mm² (3 core) & 16mm² (2 core); Cu - 2.5 mm²

4.07.02 Apart from above, consideration shall also be given to limit the cable to some standard sizes instead of using too many types.

4.07.03 The standard cable sizes, amp capacities, derating factors, as given in IS/IEC will be generally followed.

4.07.04 a) For breaker protected circuits minimum size of the cable shall be as follows:

1100V Power Cable : 240 Sq mm XLPE AL

6600V & 3300V Power Cable : 185 Sq mm XLPE AL

11000V Power Cable : 240 Sq mm XLPE AL

- b) For motor circuits the selection of size will be made ensuring that the cable shall withstand a short circuit fault directly following a second hot start.

4.07.05 For fuse/MCCB protected circuit, the conductor size will depend on full load current subject to voltage drop not exceeding 3%. For practical purposes, the minimum size chosen is as below :

a) Aluminium : 16 Sq mm.

b) Copper : 2.5 Sq mm.

4.07.06 All control cables shall be 2.5 Sq mm stranded copper cable.

4.07.07 Multicore control cables will generally have spare conductor (s) in accordance with the following chart :

Conductors required	Cables
1 or 2	1-3/C
3 or 4	1-5/C
5 or 6	1-7/C

7 or 8	1-9/C
9 or 10	1-12/C
Above 10	Two or more of above cables

4.07.08 Separate cables for each type of following services/functions as applicable shall be used for each feeder. Same multicore cable using different services shall not be acceptable.

- a) Power.
- b) Control, interlock and indication.
- c) Metering and measuring.
- d) Alarm and annunciation.
- e) C.T. Cables.
- f) V.T. Cables.

4.08.00 **Cable Identification**

Cable identification shall be provided by embossing on the outer sheath the following :

- a) Manufacturer's name or trade mark
- b) Manufacturer's name or trade mark
- c) Voltage grade
- d) Year of manufacture
- e) Type of insulation, e.g. XLPE, HRPVC & IE2 etc.
- f) No. of core & size of cables
- g) Type of outer sheath e.g. FRLS, FS etc.

4.09.00 Selected sizes of power and control cables are given in Annexure-G.

4.10.00 Fire Survival Cables shall be used for important auxiliaries / area as recommended by Standard Technical Specification by CEA as below for the following :

Fire Survival Power & Control Cables shall be used for important auxiliaries/ areas like:

- i. DC emergency lube oil pump
- ii. DC hydrogen seal pump
- iii. Turbine lube oil pump/barring gear

- iv. DC emergency lighting for main building and service building
- v. DC cables for battery to charger & DC distribution boards
- vi. Jacking oil pump
- vii. Emergency turbine trip in control room
- viii. Boiler Turbine : Generator inter trip which include the interconnection between
 - Boiler master fuel trip and turbine trip relays
 - Generator trip relays & turbine trip relays
 - Generator trip relays & generator breaker
 - Generator trip relays & field breaker
 - Generator trip relays & unit auxiliary transformer breaker
 - Incomer cables for DG board, emergency board, DC lighting board etc.

5.00.00 TESTS

5.01.00 Shop Tests

The Cables shall be subject to shop tests in accordance relevant IS/IEC standards to prove the design and general qualities of the Cables as below:

5.01.01 Routine tests on each drum of cables.

5.01.02 Acceptance Tests on 1 drum out of every 10 drums chosen at random for acceptance of the lot for every size.

5.01.03 Type test on each type and size of cable, inclusive of measurement of armour DC resistance of power cables on one drum out of every 10 drums of cable.

5.02.00 Additional Tests

Following additional acceptance tests shall also be performed on each type of cables having outer sheath with improved fire performance (Type FRLS, FS):

5.02.01 Oxygen index test

The Oxygen index shall not be less than 29.

5.02.02 Temperature Index Test

The measured value of temperature index shall be 21 at a temperature of 250°C for FRLS cables and 350°C for FS cables

5.02.03 Flame Retardance test on single cable and on bunched cables

After the test, there should be no visible damages on the test specimen within 300mm from its upper end.

After burning has ceased, the cables should be wiped clean and the charred or affected portion should not have reached a height exceeding 2.5 meter above the bottom edge of the burner, measured at the front and rear of the cable assembly. 3 Hours fire rating test shall be carried out for FS cable as per IEC331

5.02.04 Halogen acid gas evolution test

The level of HCL evolved shall not exceed 20 per cent by weight. HCL evolved shall not be exceed 2% for FS cable.

5.02.05 Smoke density test

The test shall be smoke generation by the outer sheath under fire as per ASTM D 2843. The FRLS cables shall meet the requirements of light transmission of minimum 40% after the test. Minimum transmission shall be 80% for Fire Survival cables.

5.02.06 Test for specific optical density of smoke

The cables shall meet the requirements of IS/IEC.

5.02.07 Test for rodent & termite repulsion property

The test shall be carried out to note the presence of rodent and termite repelling chemical in PVC compound. Normal procedure is that a few chippings of the PVC compound are slowly ignited in a porcelain dish or crucible in a muffle furnace at about 600°C. The resulting ignited ash is boiled with a little ammonium acetate solution (10%). A drop of aqueous sodium sulphide solution is placed on a thick filter paper and it is allowed to soak. The spot is touched with a drop of above extract. A black spot indicates the presence of anti-termite & rodent compound.

Flammability test shall be carried on finished cables as per following standards-

- a) Swedish Chimney test – SS: 424-14-75
- b) IEEE std.383 – 1974 latest
- c) IEC std. 332-1 and IEC 331

5.03.00 Test Witness

Tests shall be performed in presence of Owner/Purchaser's representative. The Contractor shall give at least thirty (30) days' advance notice of the date when the tests are to be carried out.

5.04.00 Test Certificates

5.04.01 Certified reports of all the tests carried out at the works shall be furnished for approval of the Owner/Purchaser.

5.04.02 Test reports shall be completed with all details and shall also contain IS/IEC specified limit values, wherever applicable, to facilitate review.

5.04.03 The cables shall be dispatched from works only after receipt of Owner/ Purchaser's written approval of the test reports.

6.00.00 DRAWINGS, DATA & MANUALS

6.01.00 Drawings, Data and Manuals shall be submitted with the bid and for approval/ reference and subsequent distribution after the issue of Letter of Intent in quantities and procedures as specified in General condition of contract and/or elsewhere in this specification.

6.02.00 To be submitted with the Bid

- a) Manufacturer's catalogues giving cable construction details and characteristics.
- b) Cable current ratings for different types of installation, inclusive of derating factors for ambient temperature, grouping etc.
- c) Write-up on Manufacturer's recommended method of splicing, jointing, termination etc. of the cables.
- d) Type test reports on 11 KV, 6.6KV, 3.3 KV Power, LT FRLS Power & control, FS power and control cables
- e) Filled-up proposal particulars.

6.03.00 To be submitted after award of contract

6.03.01 Guaranteed Technical Particulars

6.03.02 Quality assurance plan

6.03.03 Shop Test reports

6.03.04 Instruction manuals

The manual shall clearly indicate method of laying, termination, check-ups and tests to be carried out before commissioning.

6.04.00 The bidder may note that the drawings, data and manuals listed herein are minimum requirement only. The bidder shall ensure that all other necessary write-up, information, etc required to fully describe the cable are to be submitted with the bid.

ANNEXURE-A

RATINGS AND REQUIREMENTS HV POWER CABLES (11 KV, 6.6KV & 3.3 KV)

- 1.0 11000/11000V, 6600/6600V & 3300/3300V grade 90⁰C continuous rating under normal condition and 250⁰C rating under short circuit condition heavy duty XLPE power cable suitable for use in 11000V/6600V/3300V non-effectively earthed system conforming to following requirement and in line with IS-7098, IS-8130, IS-5831 & IS-3975, manufactured by Triple Extrusion Dry Cure (CCV) process using pressurized Nitrogen.
- 1.1 Conductor : Stranded and compacted aluminium conductor of grade H2 & class 2 for all sizes, generally conforming to IS: 8130.
- 1.2 Conductor Screen : Extruded semi-conducting compound.
- 1.3 Insulation : Extruded cross linked polyethylene (XLPE) conforming to IS: 7098 (Part-2)
- 1.4 Insulation Screen : Extruded semi-conducting compound with a layer of non-magnetic metallic tape. For single core armoured cables, the armouring shall constitute the metallic part of screening. The semi-conducting tape shall be easily strippable.
- 1.5 Core Identification : By coloured strips applied on (For three core cables) cores or by numerals.
- 1.6 Inner Sheath : Extruded HRPVC/FRLS compound conforming to type ST2 of IS: 5831 for three core cables. Single core cables shall have inner sheath. Filler material shall also be of type ST2 PVC.
- 1.7 Armour : Galvanised single round steel wire armour for twin and multicore cables.

Non-magnetic hard drawn aluminum single round wire conforming to H4 of IS-8130 latest for single core cables
- 1.8 Overall Sheath : Extruded FRLS HRPVC compound conforming to type ST2 of IS: 5831.
- 1.9 Drum : Steel Drum

ANNEXURE-B

**RATINGS AND REQUIREMENTS
LV POWER CABLES [1.1KV (XLPE TYPE)]**

- 1.0 1100 V grade, 90°C continuous rating under normal condition and 250°C under short circuit condition rating, XLPE heavy duty, power cable conforming to following requirement and in line with IS 7098 Part-I. IS 8130 & IS 5831 and IS 3975.
- 1.1 Conductor : Stranded and compacted plain aluminium of grade H2 and class 2 stranded, high conductivity annealed plain copper for cable sizes upto 2.5 mm² conforming to IS:8130.
- 1.2 Insulation : Extruded cross-linked polyethylene (XLPE) conforming to IS: 7098 (Part-1)
- 1.3 Core Identification : By color coding
- 1.4 Inner Sheath : Extruded HRPVC FRLS compound conforming to type ST2 of IS: 5831 for multicore cable. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST2
- 1.5 Armour : Galvanized single round steel wire armour for twin and multicore cables.

Non-magnetic hard drawn aluminum single round wire conforming to H4 of IS-8130 latest for single core cables
- 1.6 Overall Sheath : Extruded FRLS HRPVC compound conforming to type ST2 of IS: 5831.
- 1.7 Drum : Conforming to IS-10418 (Wooden drum)

ANNEXURE-C

**RATINGS AND REQUIREMENTS
CONTROL CABLES**

- 1.0 1100 V grade 85°C continuous rating under normal condition and 160°C under short circuit condition rating HRPVC Control cable (YWW) conforming to following requirement and in line with IS:1554, IS:8130, IS:5831 and IS:3975.
- 1.1 Conductor : Stranded, non-compacted & circular, high conductivity annealed plain copper, generally conforming to IS: 8130.
- 1.2 Insulation : Extruded HRPVC type-C compound conforming to IS: 5831. The minimum volume resistivity of insulation shall be 3.5×10^{14} ohm-cm at 27°C and 3.5×10^{11} OHM-CM at 85°C.
- 1.3 Core Identification : By color coding and numbering at interval of 100mm or less
- 1.4 Inner sheath : Extruded HRPVC compound conforming to type ST2 FRLS of IS: 5831 for multicore cables. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST2.
- 1.5 Armour : Galvanised single round steel wire for twin and multicore cables.
- 1.6 Overall sheath : Extruded FRLS HRPVC compound conforming to type ST2 of IS: 5831.
- 1.7 Drum : conforming to IS: 10418 (Wooden drum)

ANNEXURE-D

**RATINGS AND REQUIREMENTS
(1.1KV GRADE COPPER CONDUCTOR FS POWER CABLES)**

- 1.1 Conductor : Conductor shall be of stranded construction, consisting of high conductivity annealed tinned copper wires conforming to Class-II of IS 8130.
- A suitable heat barrier tape, preferably glass mica tape shall be provided over the conductor.
- 1.2 Insulation : The insulation shall consist of heat resisting electrometric material EPR (Ethylene Propylene rubber) and shall conform to Type IE-2 of IS: 6380/1984 amended up to date.
- 1.3 Laying up of cores
(For multicore cables only) : The core shall be suitably identified in accordance with IS: 9968 (Part-I).
- The suitable fire retardant material fillers shall be used for filling in the interstices.
- Two layers of plain glass fibre binder tape shall be applied over the laid up cores.
- 1.4 Inner Sheath : An inner sheath of extruded special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric (HOFR) compound of black colour conforming to Type SE-3 of IS – 6380/1984, ammended up to date, shall be provided over the laid up cores. This shall be provided even for single core cables after providing two layers of plain glass fibre tape over the insulation.
- 1.5 Armour : For Single core cables to be used in A.C. system, the armouring over inner sheath shall consist of single layer of round copper wire.
- For multi-core cables to be used in A.C. system and single/two core cables in D.C. System, the armouring over inner sheath shall consist of single layer of round galvanised steel wire.

1.6 Outer Sheath : The extruded outer sheath shall be of special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric HOFR compound comprising of synthetic rubber and shall generally conform to the type SE-3 of IS: 6380 latest revision.

Minimum value of 'Tensile Strength' and 'Percentage elongation at rupture' shall be 8 Newton/sq.mm. and 250% respectively.

The colour of outer sheath shall be black or any other colour agreed mutually between Owner & Contractor.

ANNEXURE-E

ANNEXURE-E

**RATINGS AND REQUIREMENTS
(1.1KV GRADE COPPER CONDUCTOR FS CONTROL CABLES)**

- 1.1 Conductor : It shall be of stranded construction, consisting of high conductivity annealed tinned copper conductors conforming to IS:8130 / 1984 amended upto date.
- A suitable heat barrier tape, preferably glass mica tape shall be provided over conductor.
- 1.2 Insulation : The conductor insulation shall consist of heat resisting elastomeric material EPR (Ethelene Propylene rubber) and shall conform to type IE-2 of IS: 6380/1984 latest revision.
- 1.3 Laying up of cores
(For multicore cables only) :
- The core shall be suitably identified in accordance with IS: 9968 (Part-I)
- The suitable fire retardant material fillers shall be used for filling in the interstices.
- Two layers of plain glass fiber binder tape shall be applied over the laid up cores.
- 1.4 Inner Sheath : An inner sheath of extruded very low halogen (acid gas generation shall be less than 2% by weight) elastomeric HOFR compound of black colour or any other natural colour with prior approval from Owner conforming to Type SE3 of IS 6380 / 1984 amended upto date shall be provided over the laid up cores.
- 1.5 Armour : The armouring over inner sheath shall consist of single layer of wire / round galvanised steel wire as per IS 3975 amended upto date.
- 1.6 Outer Sheath : The outer sheath shall be of special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric HOFR compound comprising of synthetic rubber and shall generally conform to the type SE-3 of IS:6380 latest revision.
- The colour of outer sheath shall be black or any other natural colour with prior approval of the Owner.

ANNEXURE-F

**RATINGS AND REQUIREMENTS
FLEXIBLE TRAILING CABLES**

i) 6600 V Unearthed Grade

Flexible trailing cable, annealed plain copper conductor, Class-5 of IS-8130, insulated with EPR, conductor and insulation shielded with EPR, cores screened with ATC wire braiding, cores laid up, HD CSP inner sheathed, proof cotton taped and FRLS HD CSP sheathed overall, conforming to IS:9968. Alternatively PCP sheathing may be acceptable.

ii) 1100 V Grade

1100 V Grade trailing cable shall be plain copper of Class-5 of IS-8130, heat resistant elastomeric compound based on EPR insulation, inner sheath of heat resistant elastomeric compound PCP sheath, nylon cord reinforcement and heat resistant, oil resistant and flame retardant heavy duty elastomeric compound FRLS CSP outer sheath.

ANNEXURE-G

CABLE SIZES

Sl. No.	Cable Size	Conductor	Insulation
1.0	H. T. CABLES (11kV)		
1.1	1 core 630 Sq.mm	AL	XLPE (FRLS)
1.2	3 core 400 Sq.mm	AL	XLPE (FRLS)
1.3	3 core 240 Sq.mm	AL	XLPE (FRLS)
1.4	1 core 70 Sq.mm	AL	XLPE (FRLS)
1.0	H. T. CABLES (6.6kV & 3.3kV)		
1.1	1 core 630 Sq.mm	AL	XLPE (FRLS)
1.2	3 core 300 Sq.mm	AL	XLPE (FRLS)
1.3	3 core 240 Sq.mm	AL	XLPE (FRLS)
1.4	3 core 185 Sq.mm	AL	XLPE (FRLS)
1.5	1 core 70 Sq.mm	AL	XLPE (FRLS)
2.0	L. T. POWER CABLES		
2.1	3 core 2.5 Sq.mm	CU	XLPE (FRLS)
2.2	3 or 4 core 4.0 Sq. mm	CU	XLPE (FRLS)
2.3	3 or 4 core 10 Sq.mm	CU	XLPE (FRLS)
2.4	2 core 16 Sq.mm	AL	XLPE (FRLS)
2.5	3 core 16 Sq.mm	AL	XLPE (FRLS)
2.6	4 core 16 Sq.mm	AL	XLPE (FRLS)
2.7	2 core 35 Sq.mm	AL	XLPE (FRLS)
2.8	3 core 35 Sq.mm	AL	XLPE (FRLS)
2.9	4 core 35 Sq.mm	AL	XLPE (FRLS)
2.10	3 core 70 Sq.mm	AL	XLPE (FRLS)

Sl. No.	Cable Size	Conductor	Insulation
2.11	3.1/2 core 70 Sq.mm	AL	XLPE (FRLS)
2.12	3 core 95 Sq.mm	AL	XLPE (FRLS)
2.13	3.1/2 core 95 Sq.mm	AL	XLPE (FRLS)
2.14	3 core 185 Sq.mm	AL	XLPE (FRLS)
2.15	3.1/2 core 185 Sq.mm	AL	XLPE (FRLS)
2.16	3 core 240 Sq.mm	AL	XLPE (FRLS)
2.17	3.1/2 core 240 Sq.mm	AL	XLPE (FRLS)
2.18	3 core 300 Sq.mm	AL	XLPE (FRLS)
2.19	3.1/2 core 300 Sq.mm	AL	XLPE (FRLS)
2.20	1 core 630 Sq.mm	AL	XLPE (FRLS)
3.0	CONTROL CABLE		
3.1	2 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.2	3 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.3	5 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.4	7 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.5	9 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.6	12 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.7	20 core 2.5 Sq.mm	CU	HRPVC (FRLS)
4.0	FS POWER CABLES		
4.1	3 core 2.5 Sq.mm	CU	EPR
4.2	2 core 16 Sq.mm	CU	EPR
4.3	3 core 16 Sq.mm	CU	EPR
4.4	4 core 16 Sq.mm	CU	EPR
4.5	2 core 35 Sq.mm	CU	EPR

Sl. No.	Cable Size	Conductor	Insulation
4.6	3 core 35 Sq.mm	CU	EPR
4.7	4 core 35 Sq.mm	CU	EPR
4.8	3 core 95 Sq.mm	CU	EPR
4.9	3.1/2 core 95 Sq.mm	CU	EPR
5.0	FS CONTROL CABLE		
5.1	2 core 2.5 Sq.mm	CU	EPR
5.2	3 core 2.5 Sq.mm	CU	EPR
5.3	5 core 2.5 Sq.mm	CU	EPR
5.4	7 core 2.5 Sq.mm	CU	EPR
5.5	9 core 2.5 Sq.mm	CU	EPR
5.6	12 core 2.5 Sq.mm	CU	EPR

	TITLE: 1x800 MW WANAKBORI STPP TECHNICAL SPECIFICATION FOR EFFLUENT TREATMENT PLANT	SPEC NO: PE-TS-408-164-A001	
		VOLUME: II-B	
		SECTION: D3	
		REV NO: 00	DATE:

SECTION-D3

(GENERAL TECHNICAL REQUIREMENT FOR C&I)

	1X800 MW Wanakbori STPP	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

TABLE OF CONTENTS

- A. General & Specific Technical requirement
- B. C&I deliverables list
- C. Specification for Motorized valve actuator
- D. Specification for field instruments
- E. Control panels specification
- F. Drive control philosophy
- G. Applicable codes and standards
- H. ~~Mandatory spares~~
- I. Drawings

	1X800 MW Wanakbori STPP	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
GENERAL & SPECIFIC TECHNICAL REQUIREMENT		

	1X800 MW Wanakbori STPP	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
GENERAL REQUIREMENT 1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments for the safe, efficient and reliable operation of auxiliary systems. 2.0. The quantity of instruments for auxiliary system shall be as per tender P & ID, wherever provided, for the respective system as a minimum for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication. 3.0 Measuring instruments/equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further all the instruments shall be of proven reliability, accuracy, and acceptable international standards and shall be subject to employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specification, ranges, makes/ numbers as approved by the employer' during detail engineering. 4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, switches etc. for external connection including spare contacts shall be wired out to suitably located junction boxes. 5.0 The customer specification attached as Specific Technical Requirement will supersede the Data sheets, if there is any mismatch. 6.0 All instruments shall be suitable to process medium requirements.		

	1X800 MW Wanakbori STPP	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
Specific Technical Requirements (C&I): 1. CONTROL PHILOSOPHY The control concept for Effluent Treatment System shall be such that the operation of the total Treatment System can be monitored and controlled from Local Control Panels (relay based hardware) as described hereinafter. Bidder shall provide all necessary indicating lamps, selector switches, pushbuttons, annunciation system, ammeters etc. Selected parameters from Effluent Treatment plant shall be linked to DM plant PLC via hardwired link for monitoring purpose. The quantity and type of signals shall be decided during detailing. Bidder shall supply CCTV camera along with OWS, storage media and other necessary hardware. The Control Panels shall be provided are as follows: a) One (1) no. LCP Shall be provided in ETP Chemical house to control all the drive located at ETP area [acid dosing system, alkali dosing system, guard pond, dosing pumps, transfer pumps, flash mixer, ISS, OWS, etc]. b) One (1) no. LCP shall be provided near Boiler wash water collection sump. c) One (1) no. LCP shall be provided near TG area wash water collection sump. d) One (1) no. LCP shall be provided near Oily waste from Power house TG area waste water collection sump. e) One (1) no. LCP shall be provided near Oily waste from Power house SG area waste water collection sump. f) One (1) no. LCP shall be provided near Fuel Oil Dyke area near Retention pit-1. g) One (1) no. LCP shall be provided near Transformer Year Oily waste area. h) One (1) no. LCP shall be provided near Side Stream Filtration plant back wash collection pit. The locations given above are indicative. Bidder to provide Local Control Panel for any other location envisaged during detailed engg. All pumps and agitators shall start at level high in respective tanks/pits and stop when level is low. Online flow indicator shall be provided in each effluent water sources. At discharge of clear water transfer pump online pH meter, TDS meter, Turbidity, Temperature and Flow meter etc. shall be provided by bidder to check the final discharge water quality. ON/OFF/TRIP status of all pumps, blowers and drive motors under scope of supply, ammeters for drive motors wherever required shall be displayed in Control Panels. All drive motors shall be provided with arrangement of local starting and stopping. Local starting shall be possible through remote/local selector switch in control panel or in MCC.		

	1X800 MW Wanakbori STPP	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
Tripping of drive motors locally shall be permissible irrespective of position of remote/local selector switch. Annunciation panel showing tripping of different motors shall be located in each of the Control Panels. Instrument cabling from instruments to LCP and pre-wiring within LCP shall be done by Bidder. 2) All electrical actuators shall be non-integral type. 3) The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with. 5) All the instruments/drives shall be terminated on JBs/Panels in field. JBs/Panels shall be in Bidder's scope. RTD's shall be of duplex type. 6) Scope of Instrumentation cables (Screened Control Cables), Fibre Optic cable & Control cables shall be as per Electrical Cable scope matrix in Electrical portion of specification. Any cable in Bidder's scope shall be as per specification. 7) Bidder to comply with codes and standards as mentioned in the specification. 8) All local gauges, transmitters and switches shall be mounted on suitable enclosures, racks subject to owner's approval. All transmitters shall be HART compatible. 9) Bidder to delegate /depute their persons/experts as per owner/consultants' requirement. 10) Bidder must offer general tools and tackles and special calibration instruments required during start-up, trial run, operation and maintenance of the system. 11) The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL. 12) Two nos feeders of 415 V AC shall be provided for Local Control Panels. Necessary power supply for panel, instruments etc. and any other supply like 24 V DC, 110 V AC etc. for alarm annunciator, Auto Stroke Controller etc. shall be derived from these two feeders by the bidder. The necessary hardware for the same shall be in Bidder's scope. Suitable Automatic changeover arrangement of the input feeders shall also be provided by the bidder in the LCP. Minimum 10% spare windows to be provided in each LCP. 13) Double root valve shall be provided for all pressure tappings where the pressure exceeds 40 kg/cm².		

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT						
1X800 MW WANAKBORI TPP						
DOCUMENT NUMBER PE-GL-408-145-I100						
Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CUSTOMER	FROM	USER	REMARKS
INSTRUMENTATION						
1	PE-V9-408-XXX-1901	INSTRUMENT DATA SHEETS	-	VENDOR	C&I	
2	PE-V9-408-XXX-1902	INSTRUMENT SCHEDULE	-	VENDOR	C&I	
3	PE-V9-408-XXX-1903	INSTRUMENT INSTALLATION/ HOOK UP DIAGRAMS	-	VENDOR	C&I	
5	PE-V9-408-XXX-1905	INSTRUMENT QP/CHECK LIST	-	VENDOR	C&I	
LOCAL CONTROL PANEL						
1	PE-V9-408-XXX-1950	LOCAL CONTROL PANEL DATASHEET	A	VENDOR	C&I	
2	PE-V9-408-XXX-1951	WIRING DIAGRAM	-	VENDOR	C&I	
3	PE-V9-408-XXX-1952	PANEL GA DRAWINGS	-	VENDOR	C&I	
8	PE-V9-408-XXX-1956	BILL OF MATERIAL	-	VENDOR	C&I	
13	PE-V9-408-XXX-1957	LOCAL CONTROL PANEL QUALITY PLAN	,	VENDOR	C&I	
14	PE-V9-408-XXX-1958	LOCAL CONTROL PANEL O&M MANUAL	-	VENDOR	C&I	
19	PE-V9-408-XXX-1925	MANDATORY SPARES BILL OF MATERIAL	A	VENDOR	C&I	
	Notes:	408 - Project No.				
		XXX -MAX Package Code				
		\$ \$ -Approval by BHEL if Vendor BBU Item. Approval by Customer if Customer BBU Item				

NOTE: THIS LIST SHALL BE FINALIZED DURING DETAILED ENGINEERING.

	1X800 MW Wanakbori STPP	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
SPECIFICATION FOR MOTORISED VALVE ACTUATOR		

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.: PE-ID-408-145-1902	
			VOLUME II B	
			SECTION D	
			REV. NO. 00	DATE: 04.04.15
			SHEET 1	OF 3
Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	

408

GENERAL*	* PROJECT		
	OFFER REFERENCE		
	* TAG NO. SERVICE		
	* DUTY	☐ ON / OFF	☐ INCHING
	* LINE SIZE (inlet/outlet): MATERIAL		
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY	
	* OPENING / CLOSING TIME		
	* WORKING PRESSURE		
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%	
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY	
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY	
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY	
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, IPW:55	
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL	
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.	
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.	
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER FOR INCHING SERVICE - 150 STARTS/HR MINIMUM & FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM.	
HANDWHEEL	* REQUIRED	☒ YES ☐ NO	
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED	
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.		
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY	
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY	
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT- INCLUSIVE OF I.S. TOLERANCE	
	ACTUATOR APPLICABLE WIRING DIAGRAM	☒ ENCLOSED (BIDDER TO CONFIRM) A: ☐ DRG. NO. 3-V-MISC-24227 R00 B: ☐ DRG. NO. 3-V-MISC-24550 R00 C: ☐ DRG. NO. 3-V-MISC-24283 R00 D: ☒ DRG. NO. 4-V-MISC-90271 R11 E: ☐ For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram	
	COLOUR SHADE	☐ BLUE (RAL 5012) ☐ (TO BE DECIDED BY BHEL DURING DETAIL ENGG.)	
	PAINT TYPE (## Refer Notes)	☐ ENAMEL ☐ EPOXY ☐ (TO BE DECIDED BY BHEL DURING DETAIL ENGG.)	
	SHAFT RPM	BIDDER TO SPECIFY	
	OLR SET VALUE	BIDDER TO SPECIFY	
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY	
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY	

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR	SPECIFICATION NO.: PE-ID-408-145-I902		
		VOLUME	II B	
		SECTION	D	
		REV. NO.	00	DATE: 04.04.15
		SHEET	2	OF 3
Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)		

408

	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC		
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ☒ 110 V		
	@ ENCLOSURE CLASS OF MOTOR	☒ IP 65 ☐ FLAME PROOF		
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B		
	@ WINDING TEMP PROTECTION	☒ THERMOSTAT (3 Nos., 1 IN EACH PHASE) ☒ ---THERMOSTAT- 1 NO+1 NC CONTACT -----		
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED		
INTEGRAL STARTER	INTEGRAL STARTER	☐ REQUIRED ☒ NOT REQUIRED		
	TYPE OF SWITCHING DEVICE	☐ CONTACTORS ☐ THYRISTORS		
	TYPE	☐ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)		
	IF SMART			
	a) SERIAL LINK INTERFACE	☐ INTEGRAL ☐ FIELD MOUNTED		
	b) SERIAL LINK PROTOCOL	☐ FOUNDATION FIELD-BUS ☐ PROFI-BUS ☐ DEVICE NET ☐		
	c) SERIAL LINK MEDIA	☐ TWISTED PAIR Cu-CBL ☐ CO-AXIAL Cu-CBL ☐ OFC		
	d) HAND HELD PROGRAMMER	☐ REQUIRED ☐ NOT REQUIRED		
	e) TYPE OF HAND HELD PROGRAMMER	☐ BLUETOOTH ☐ INFRARED ☐		
	f) MASTER STATION	☐ REQUIRED ☐ NOT REQUIRED		
	g) MASTER STN INTRFACE WITH DCS	☐ MODBUS ☐ TCP/IP		
	h) DETAILS OF SPECIAL CABLE	☐ ENCLOSED ☐ NOT REQUIRED		
	STEP DOWN CONT. TRANSFORMER	☐ REQUIRED		
	OPEN / CLOSE PB	☐ REQUIRED ☐ NOT REQUIRED		
	STOP PB	☐ REQUIRED ☐ NOT REQUIRED		
	INDICATING LAMPS	☐ REQUIRED ☐ NOT REQUIRED		
	LOCAL REMOTE S/S	☐ REQUIRED ☐ NOT REQUIRED		
	STATUS CONTACTS FOR MONITORING	☐ REQUIRED ☐ NOT REQUIRED		
INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY)			
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	☐ INTERPOSING RELAY ☐ OPTO COUPLER ☐ EITHER		
	QUANTITY	☐ 2 NOs. ☐ 3 NOs.		
	DRIVING VOLTAGE	☒ 20.5 – 24V DC ☐ _____ V DC		
	DRIVING CURRENT	☒ 125mA MAX ☐ _____ mA MAX		
	LOAD RESISTANCE	☒ > 192 ohms - <25 k ohms ☐ > _____ ohms - < _____ ohms		
TORQUE SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY		
	OPEN / CLOSE	☒ 1 No. ☐ 2Nos. / ☒ 1 No. ☐ 2Nos		
	CONTACT TYPE	2 NO + 2 NC		
	RATING	5A 240V AC AND 0.5A 220V DC		
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE		
	ACCURACY	+3% OF SET VALUE		

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR	SPECIFICATION NO.: PE-ID-408-145-I902		
		VOLUME	II B	
		SECTION	D	
		REV. NO.	00	DATE: 04.04.15
		SHEET	3	OF 3
Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	

408

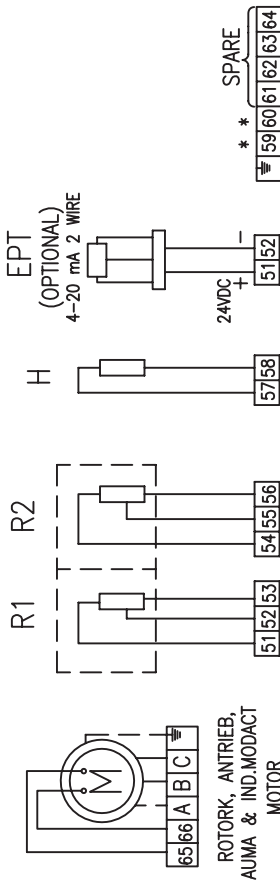
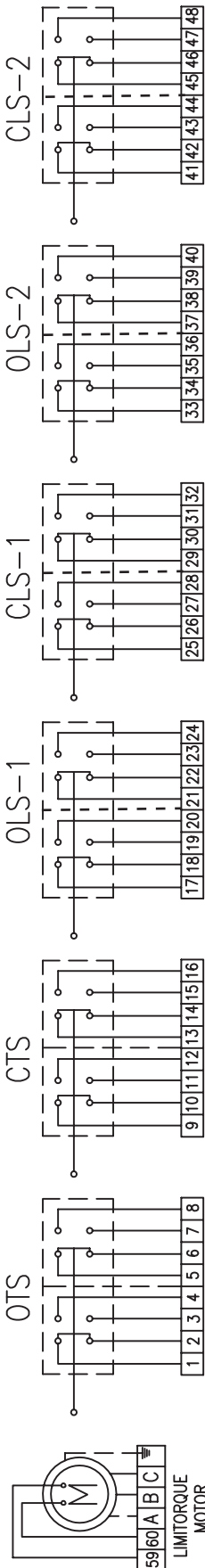
LIMIT SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY		
	OPEN : INT : CLOSE	☐ 1 No. ☒ 2 Nos.	2 Nos. (ADJ.)	☐ 1 No. ☒ 2Nos.
	CONTACT TYPE	2 NO + 2 NC		
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC		

POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications)	☒ REQUIRED ☐ NOT REQUIRED
	MFR & MODEL NO.	BIDDER TO SPECIFY
	TYPE	☒ ELECTRONIC (2 WIRE) R/I CONVERTER ☐ ELECTRONIC (2 WIRE) CONTACTLESS
	SUPPLY	☒ 24V DC ☐
	OUTPUT	☒ 4-20mA
	ACCURACY	± 1% FS
SPACE HEATER	@SPACE HEATER	REQUIRED
	@ POWER SUPPLY (NON INTEGRAL)	230V AC, 1 PH., 50 Hz
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY
	@ RATING	decided as per load data received tender stage
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED
	ENCL CLASS ACTUATOR/MOTOR T.B.	@ ☐ IP 68 @ ☐
	@ EARTHING TERMINAL	REQUIRED
	PLUG & SOCKET (9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	☐ REQUIRED ☐ NOT REQUIRED ☐ 2 NOS. ☐
CABLE GLANDS	@ POWER CABLE GLAND	SIZE: decided as per load data received tender stage
	@ SPACE HEATER CABLE GLAND	SIZE: decided as per load data received tender stage
	OTHER CONTROL CABLE GLANDS-1	☐ 1No. for BFV of CW PUMP (Cable size 2Px1.5mm2)
	OTHER CONTROL CABLE GLANDS-2	QUANTITY & SIZE :-----

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR	SPECIFICATION NO.: PE-ID-408-145-I902		
		VOLUME	II B	
		SECTION	D	
		REV. NO.	00	DATE: 04.04.15
		SHEET	4	OF 3
Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	

408

WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.	
NOTES: 1. SCOPE: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY. 2. CODES & STANDARDS: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH: IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722 3. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C. 4. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED. 5. THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION. THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE. 6. THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%. 7. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING. 8. CANOPY FOR OUTDOOR SERVICES SHALL BE PROVIDED. \$\$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE. ## EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.				
NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL NAME SIGNATURE DATE
NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @ = TO BE FILLED BY ES				



* - SPARE FOR ROTORK, AUMA, ANTRIEB & IND.MODACT

SWITCHES - ALL ARE POTENTIAL FREE AND TWO PAIR OF CONTACTS CAN BE USED FOR DIFFERENT SUPPLY THERMOSTAT - 65-66 (ROTORK, AUMA, ANTRIEB & IND.MODACT), 59-60 (LIMITORQUE).

EPT - ELECTRONIC POSITION TRANSMITTER (POTENTIOMETRIC TYPE, FOR INCHING DUTY)

THERMOSTAT TERMINALS - TERMINATED IN MOTOR TB IN ANTRIEB & IND.MODACT AND IN MAIN TB IN OTHER MAKES

CTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE) - 2 NO+2 NC

OTS - TORQUE SWITCHES FOR CCW ROTATION (OPEN) - 2 NO+2 NC

OLS-1, OLS-2 - LIMITSWITCHES FOR POSITION OPEN - 2 NO+2 NC

CLS-1, CLS-2 - LIMITSWITCHES FOR POSITION CLOSE - 2 NO+2 NC

OTS, CTS - TWO INDEPENDENT SWITCHES IN ANTRIEB & LIMITORQUE

OLS-2 & CLS-2 - CAM DISC IN ROTORK & ANTRIEB

R1-R2- POTENTIOMETER 2 x 100 OHMS

H - SPACE HEATER 1ø 240V AC SUPPLY

M - MOTOR 3ø 415V 50 Hz AC SUPPLY

CONTACT DEVELOPMENT DIAGRAM						
OTS	1-2	OFF AT OVER TORQUE DURING OPENING TRAVEL				
	5-6	ON AT OVER TORQUE DURING OPENING TRAVEL				
	3-4	ON AT OVER TORQUE DURING OPENING TRAVEL				
	7-8	ON AT OVER TORQUE DURING OPENING TRAVEL				
CTS	9-10	OFF AT OVER TORQUE DURING CLOSING TRAVEL				
	13-14	ON AT OVER TORQUE DURING CLOSING TRAVEL				
	11-12	ON AT OVER TORQUE DURING CLOSING TRAVEL				
	15-16	ON AT OVER TORQUE DURING CLOSING TRAVEL				
OLS-1	17-18					
	21-22					
	19-20					
	23-24					
CLS-1	25-26					
	29-30					
	27-28					
	31-32					
OLS-2	33-34					
	37-38					
	35-36					
	39-40					
CLS-2	41-42					
	45-46					
	43-44					
	47-48					
SWITCH	TERMINAL NO.	VALVE POSITION				
	FULL OPEN	a	INTERMEDIATE	b	FULL CLOSE	
INDICATES CONTACT CLOSED						
INDICATES CONTACT OPEN						

CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH				
VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS	CLS	CTS

⊕ - CLS NOT TO BE CONNECTED IN TRIP CIRCUIT

NOTE:

1. BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)
2. CONNECT THERMOSTAT WITHOUT FAIL IN THE STARTER CIRCUIT

		BHARAT HEAVY ELECTRICALS LTD.	
		UNIT: HIGH PRESSURE BOILER PLANT, TIRUCHIRAPPALLI 620014.	
365-139		TITLE	
N.P.ESWAR		DRAWN	
KARUNACHALAM		CHECKED	
P.LOGANATHAN		APPROVED	
09.09.2000		DATE	
11		CONTACT DEV. FIG. ADDED.	
REV	DATE	CHD	APPD
DRAWING No.		DESCRIPTION	
4-V-MISC-90271		RETRACTED WITH REVISION 11	
REV		REV	
11			

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	STANDARDS
3.00.00	SERVICE CONDITIONS
4.00.00	RATING
5.00.00	PERFORMANCE
6.00.00	SPECIFIC REQUIREMENT
7.00.00	TEST
8.00.00	DRAWINGS, DATA & MANUALS

VOLUME : IIF/1

SECTION-III

**TECHNICAL SPECIFICATION
FOR
ELECTRIC MOTOR ACTUATORS**

1.00.00 SCOPE

1.01.00 This Section covers the general requirements of Electric Motor Actuators for valves, dampers and gates.

1.02.00 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification.

2.00.00 STANDARDS

2.01.00 All electrical equipment shall conform to the latest applicable IS, ANSI and NEMA Standards, except when stated otherwise herein or in driven equipment specification.

2.02.00 Major standards, which shall be followed, are listed below. Other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed

i) IS-9334

ii) IS-325

3.00.00 SERVICE CONDITIONS

3.01.00 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.

3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the general specification.

3.03.00 For actuator motor installed outdoor and exposed to direct sun rays , the effect of solar heat [manufacturer to decide] shall be considered or overhead shed shall be provided locally to avoid direct sun rays.

4.00.00 RATING

4.01.00 For isolating service, the actuator shall be rated for three successive open-close operation of the valve/damper or 15 minutes, whichever is longer.

4.02.00 For regulating service, the actuator shall be suitably time-rated for the duty cycle involved with necessary number of starts per hour, but in no case less than 150 starts per hour.

5.00.00 **PERFORMANCE**

The actuator shall meet the following performance requirements:

5.01.00 Open and close the valve completely and make leak-tight valve closure without jamming.

5.02.00 Attain full speed operation before valve load is encountered and impart an unseating blow to start the valve in motion (hammer blow effect).

5.03.00 Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.

5.04.00 The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.

5.05.00 The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.

6.00.00 **SPECIFIC REQUIREMENT**

6.01.00 **Construction**

6.01.01 The actuator shall essentially comprise the drive motor, torque/ limit switches, gear train, clutch, hand wheel, position indicator/ transmitter, in-built thermostat for over load protection, space heater and internal wiring. Actuator shall be non integral type.

6.01.02 The actuator enclosure shall be totally enclosed, dust tight, weather-proof suitable for outdoor use without necessity of any canopy.

6.01.03 All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.

6.01.04 The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.

6.02.00 **Motor**

6.02.01 The drive motor shall be three phase, squirrel cage, induction machine with minimum class B insulation and IPW-55 enclosure, designed for high torque and reversing service. Canopy shall be provided for outdoor service.

6.02.02 The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current.

6.02.03 The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each.

- 6.02.04 Motor leads shall be terminated in the limit switch compartment.
- 6.02.05 Motor actuators for valves/dampers shall be non-integral type with separate starter units and operable from remote.
- 6.02.06 Earthing terminals shall be provided on either side of the motor.
- 6.03.00 **Limit Switches**
- Each actuator shall be provided with following limit switches: -
- 6.03.01 2 torque limit switches, one for each direction of travel, self-locking, adjustable torque type.
- 6.03.02 4 end-of-travel limit switches, two for each direction of travel.
- 6.03.03 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.
- 6.03.04 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.
- 6.04.00 **Hand Wheel**
- Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall declutch automatically when the motor is energized.
- 6.05.00 Position Indicator/Transmitter
- The actuator shall have:
- 6.05.01 One (1) built-in local position indicator for 0-100% travel.
- 6.05.02 One (1) position transmitter, potentiometer type, for remote indicator.
- 6.06.00 **Space Heater**
- A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.
- 6.07.00 **Wiring**
- All electrical devices shall be wired up to and terminated in a terminal box. The internal wiring shall be of sufficient size for the power rating involved but in no case less than 1.5 Sq.mm copper. All wiring shall be identified at both ends with ferrules. All wires shall be fire resistance type.
- 6.08.00 **Terminal Box**
- The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2.5 Sq.mm copper conductor.

7.00.00 ACCESSORIES

As required for the driven equipment, the actuator shall be furnished with starting equipment mounted on the actuator. This shall include:

- 7.01.00 One (1) triple pole MCCB for local isolation near the actuator
- 7.02.00 One (1) reversing starter with mechanically interlocked contactors, 3 thermal overload relays, 2 NO + 2 NC auxiliary contacts for each contactor.
- 7.03.00 One (1) remote-local selector switch.
- 7.04.00 CLOSE-STOP-OPEN oil tight push buttons with indication lights.
- 7.05.00 415/240 V or 415/110V control transformer with primary protected by fuse & secondary protected by Miniature Circuit Breaker (MCB).

8.00.00 TEST

The actuator and all components thereof shall be subject to tests as per relevant Standards. In addition, if any special test is called for in equipment specification, the same shall be performed.

9.00.00 DRAWINGS, DATA & MANUALS

- 9.01.01 To be Submitted with Bid

Data sheet for each type of actuator shall be furnished along with internal wiring diagram, suggested control schematic and torque limit switch contact development and manufacturer's catalogues.

- 9.01.02 To be Submitted after Award of Contract

- a) Actuator Data Sheet
- b) Internal wiring diagram and suggested control schematic
- c) Torque switch and limit switch contact development
- d) Manufacturer's Catalogue
- e) Instruction manual indicating clearly the installation methods, check ups and tests to be carried out before commissioning of the equipment.
- f) Any other relevant drawings, documents or data necessary for satisfactory installation , operation and manufacturing.

- 9.02.00 The Bidder may note that the drawings, data and manuals listed herein are minimum requirements only. The Bidder shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment are submitted with his bid.

	1X800 MW Wanakbori STPP	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
SPECIFICATION FOR FIELD INSTRUMENTS		

1.00.00 FIELD INSTRUMENTS

This section provides general hardware guidelines for field instruments and equipment to be supplied under this specification.

1.01.00 Pressure Transmitter

- | | | | |
|-----|---------------------|---|---|
| 01. | Working Principle | : | Smart (HART Compatible) |
| 02. | Type | : | 2 - Wire |
| 03. | Output Signal | : | 4-20 mA DC. |
| 04. | Signal Processing | : | Silicon solid state electronic circuitry |
| 05. | Measuring Element | : | Capsule / Diaphragm |
| 06. | Element material | : | AISI-316 (Stainless Steel) or better |
| 07. | Static Pressure | : | 150 % of maximum span continuously, without affecting the calibration. |
| 08. | Turn-down ratio | : | 60: 1. |
| 09. | Span and Zero | : | Locally adjustable non-interacting. Facility for elevation and suppression by 100% of span |
| 10. | Enclosure Class | : | IP-65 |
| 11. | Output Indicator | : | LCD |
| 12. | Nameplate | : | Tag number, service engraved in SS tag plate |
| 13. | Body | : | Forged Carbon Steel for air and flue gas application and SS for other application. |
| 14. | Operating Voltage | : | 16 - 48 Volts D.C. |
| 15. | Load | : | 600 Ohms (min.) at 24 Volts D.C. |
| 16. | Ambient Temperature | : | 0 - 50 °C |
| 17. | Performance: | | |
| | i) Accuracy | : | ± 0.1% of Span or better |
| | ii) Repeatability | : | ± 0.05% of Span or better |
| | iii) Response time | : | 100 msec or better |
| 18. | Sealing/Isolation | : | Extended diaphragm with 5 meters SS armoured capillary for viscous fluid applications. |
| 19. | Accessories | : | a) Universal mounting bracket suitable for 2" pipe mounting.
b) High tensile carbon steel U- bolts.
c) Siphon for steam and hot water services.
d) ½" NPT 2-valve stainless steel manifold, constructed from SS316 bar stock.
e) Companion flange with nuts, bolts and gaskets. |

- f) ½" NPT cable gland
- 1.02.00 Differential Pressure Transmitter / Flow transmitter
01. Working Principle : Smart (HART compatible)
 02. Type : 2-Wire
 03. Output signal : 4-20 mA DC.
 04. Signal Processing Unit : Silicon solid-state electronic circuitry
 05. Measuring element : Capsule/Diaphragm
 06. Element material : AISI-316 (Stainless Steel) or better
 07. Static Pressure/
Overload Pressure : Maximum line (or static) pressure on either side without permanent deformation or loss of accuracy
 08. Turn-down ratio : 60 : 1 minimum
 09. Span and Zero : Locally adjustable, non-interacting
 10. Enclosure class : IP-65
 11. Zero suppression /
elevation : At least 100% of Span
 12. Output Indicator : LCD type
 13. Nameplate : Tag number and Service engraved in SS tag plate
 14. Body : Forged Carbon Steel for air and flue gas application and SS for other application
 15. Ambient temperature : 0 - 50 °C
 16. Operating Voltage : 16 - 48 Volts DC
 17. Load : 600 Ohms (min.) at 24 Volts DC
 18. Performance:-
 - i) Accuracy : ±0.1 % of span or better
 - ii) Repeatability : ± 0.05 % of span or better
 - iii) Response time : 100 msec or better
 19. Sealing / Isolation : Extended diaphragm with 5 meters SS armoured capillary for viscous fluid applications.
 20. Accessories :
 - a) Universal mounting bracket suitable for 2" pipe mounting.
 - b) High tensile carbon steel U-bolts.
 - c) Siphon for steam and hot water services.
 - d) Companion flange with nuts, bolts and gaskets.
 - e) ½" NPT cable gland

- f) ½" NPT generally 5-valve stainless steel manifold, constructed from SS316 bar stock. 3 valve manifold for DP application in flue gas and air.

1.03.00 Displacer Type Level Transmitters

01. Type : Smart (HART compatible)
02. Stages of operation : Continuous
03. Material -
 - i) Displacer : AISI 316 SS
 - ii) Suspension wire : AISI 316 SS
 - iii) Torque tube housing : Carbon steel or SS as per application
 - iv) Torque tube : Inconel
 - v) Displacer chamber : CS or SS as per process application
 - vi) Transmitter Housing : Die cast aluminium or better
04. Operating Voltage : 16-48 Volts D.C.
05. Transmission : 2-wire
06. Output Signal : 4-20 mA DC.
07. Signal processing : Solid-state electronic circuitry
08. Static / overload pressure : Maximum static pressure without permanent deformation or loss of accuracy.
09. Turn-down ratio : 10 : 1 or better
10. Zero & Span : Easily accessible (local zero & span adjustment and non-interactive type)
11. Enclosure Class : IP-65
12. Output Indicator : LCD type
13. Nameplate : Tag number and Service engraved in stainless steel tag plate
14. Ambient Temperature : 0 - 50 °C
15. Load Impedance : 600 Ohms at 24 Volts (minimum)
16. Process Connection : 2" Companion flange with nuts, bolts and gaskets
17. Performance -
 - Accuracy : ± 0.5 % of span or better
18. Accessories :
 - a) Counter Flange, nuts, bolts, gaskets etc.
 - b) Weights for 5 point calibration of instruments.
 - c) Vent and drain plugs
 - d) Special calibration tool/configurator, if any.
 - e) ½"NPT cable gland

- | | | | |
|---------|--|---|---|
| 19. | Preferred Features | : | a) Test plug connection and cutout terminals physically separated from other electronics.
b) Electronic Damping facility (adjustable). |
|
 | | | |
| 1.04.00 | Mass Flow meter | | |
| 1.04.01 | Sensor | | |
| 01. | Measuring Principle | : | Coriolis Mass flow. |
| 02. | Primary Element | : | Flow Tube of 316SS or better |
| 03. | Heating Arrangement | : | Integral. |
| 04. | Temperature Control | : | For heavy fuel oil application. |
| 05. | Process Connection | : | Flanged of rating as per process requirement. |
| 06. | Drain | : | Self-draining facility |
| 07. | Enclosure | : | Stainless steel |
| 08. | Accessories | : | Counter flanges, Mounting nuts, bolts, gaskets etc. |
|
 | | | |
| 1.04.02 | Transmitter | | |
| 01. | Measured quantities | : | Mass Flow rate, Total Mass Flow, Density. |
| 02. | Input Signal Processing | : | Digital Processing. |
| 03. | Display | : | Digital Display (LCD). |
| 04. | Output | : | 2 off. isolated 4-20mA DC output. |
| 05. | Load | : | < 750 ohms. |
| 06. | Power supply | : | 240V AC, 50 Hz. |
| 07. | Turn Down | : | 100:1 |
| 08. | Accuracy | : | ± 0.2 % of measured value |
| 09. | Housing | : | IP 65 |
| 10. | Nameplate | : | Tag number, service engraved in stainless steel tag plate |
| 11. | Accessories | : | a) Handheld configurator
b) Mounting U-bolts, nuts, bolts, prefab cable etc.
c) ½"NPT cable gland |
|
 | | | |
| 1.05.00 | Pressure Gauge and Differential Pressure Gauge | | |
| 01. | Type | : | Bourdon/Bellows/Diaphragm |
| 02. | Sensing & Socket | : | AISI-316 SS |
| 03. | Movement Material | : | AISI-304 SS |
| 04. | Case Material | : | Stainless steel. IP-65. |
| 05. | Dial Size | : | Generally 150 mm |
| 06. | Scale | : | Black lettering on white in 270 ° arc. |

- | | | | |
|-----|-----------------------|---|---|
| 07. | Window | : | Shatterproof glass |
| 08. | Range Selection | : | Normal process pressure: 50~70 % of range |
| 09. | Over-range Protection | : | 125% of maximum range by internal stop. External stop at zero. |
| 10. | Adjustment | : | Micrometer screw for zero. Internal micrometer screw for range. |
| 11. | Element Connection | : | Argon welding |
| 12. | Process Connection | : | 1/2" NPT (M) Bottom for local, back for panel mounting. |
| 13. | Performance | : | Accuracy of ± 1.0 % of span or better. |
| 14. | Operating ambient | : | 0 - 50 °C |
| 15. | Safety Feature | : | Blow out disc /diaphragm at the back |
| 16. | Accessories | : | <ul style="list-style-type: none"> a) Snubbers and Glycerin filled for pulsating fluid applications and at pump discharge. b) Stainless steel Diaphragm seals for viscous fluids. c) 3-Way SS316 Gauge cock for pressure gauges. d) 5-valve SS316 manifold from barstock for differential pressure gauge. e) Siphons for steam and hot water services. |
| 17. | Applicable standard | : | IS-3624 / 1996 |
| 18. | Nameplate | : | Tag number, service engraved in stainless steel tag plate |

1.06.00 Temperature Gauge

- | | | | |
|-----|--------------------------|---|--|
| 01. | Type | : | Bimetallic or gas filled. |
| 02. | Sensing Element Material | : | Bourdon - AISI-316 SS |
| 03. | Capillary Armoring | : | Stainless steel flexible |
| 04. | Movement Material | : | AISI 304 SS |
| 05. | Bulb / Stem Diameter | : | 12 mm |
| 06. | Bulb / Stem Material | : | AISI 316 |
| 07. | Capillary | : | Stainless Steel |
| 08. | Connection to well | : | ½" NPT |
| 09. | Case Material | : | Stainless steel |
| 10. | Dial Size | : | 150 mm in general |
| 11. | Scale | : | Black lettering on white in 270 ° arc. |
| 12. | Mounting | : | Surface/Panel |
| 13. | Over range Protection | : | 125 % of range or more |

- | | | | |
|-----|-----------------------|---|--|
| 14. | Instrument connection | : | Bottom for local and back for panel mounting. |
| 15. | Range | : | Normal temperature—50~70% of range. |
| 16. | Zero adjuster | : | Micrometer screw adjustable from front. |
| 17. | Window | : | Shatterproof glass. |
| 18. | Accuracy | : | ± 1 % or better |
| 19. | Enclosure Class | : | IP-65 |
| 20. | Capillary | : | 5 meters (local surface)/15.0 meters (local panel) - armoured stainless steel |
| 21. | Compensation | : | Capillary and Case Compensation |
| 22. | Accessories | : | a) Forged barstock thermowell screwed as per ASME PTC code. Process connection M 33X2 (M).

Material of construction of Thermowell:
- SS 316: In general
- Inconel: For flue gas application
- Tungsten carbide: For coal mill application. |
| 23. | Nameplate | : | Tag number, service engraved in stainless steel tag plate |
- 1.07.00 Thermocouples
- | | | | |
|-----|----------------------|---|--|
| 01. | Type | : | a) Type-J (Iron Constantan) / Type-K (Chromel Alumel) / Type-R (Pt.-Rhodium Pt.) / Type-S (90% Pt – 10% Rhodium). [As per application]

b) Duplex
c) Ungrounded |
| 02. | Wire gauge | : | 16 AWG for Type-K, 24 AWG for Type-R |
| 03. | Standard | : | ANSI-MC 96.1. |
| 04. | Protecting Tube :- | | |
| | i) O.D. | : | 8 mm |
| | ii) Material | : | 316-SS Seamless |
| | iii) Filling | : | Magnesium Oxide (Purity above 99.4%) |
| 05. | Response time | : | a) < 20 seconds for measurement.
b) < 10 seconds for control. |
| 06. | Accuracy | : | ± 1.1 ⁰ C up to 300 ⁰ C & 0.4% of measured temperature range above 300 ⁰ C. |
| 07. | Head: | | |
| | i) Type | : | IP-65 universal screwed type. |
| | ii) Material | : | Die cast aluminum or better |
| | iii) Terminal blocks | : | Nickel plated Brass - screw type/ silver plated |

- iv) Instrument connection : 1/2" NPT to well
- v) Cable connection : 1/2" NPT gland and grommet.
- vi) Others : Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells.

08. Accessories :
- a) Adjustable nipple-union-nipple [1/2" Sch 80 X 1/2" NPT (M)] with thermowell connection
 - b) Compression fittings/unions
 - c) Flanges etc. (for flanged connections only)
 - d) Forged barstock thermowell as per ASME PTC code. Process connection M 33X2 (M) in general or 1 1/2" Flanged for Flue gas/Furnace/Air etc. application.

Material of construction of Thermowell:

SS 316: In general

Inconel: For flue gas application

Tungsten carbide: For coal mill application.

09. Nameplate : Tag number, service engraved in stainless steel tag plate

1.08.00 Resistance Temperature Detector

- 01. Type : Platinum (Duplex), Ungrounded
- 02. Resistance : 100 ohm at 0 °C
- 03. Base : Wound on ceramic (anti-inductive)
- 04. Wiring : 3 /4 Wire
- 05. Protecting Tube :-
 - i) O.D. : 8 mm
 - ii) Material : SS-316, Seamless
 - iii) Filling : Magnesium oxide (Purity above 99.4%).
- 06. Response time :
 - a) < 20 seconds for measurement.
 - b) < 10 seconds for control.
- 07. Calibration : DIN 43760
- 08. Accuracy : ± 0.5%
- 09. Head :

- | | | |
|---------|--------------------------|--|
| | i) Type | : IP-65 universal screwed type. |
| | ii) Material | : Die cast aluminum or better |
| | iii) Terminal blocks | : Nickel plated Brass-screw type / silver plated |
| | iv) Cable connection | : ½" NPT gland and grommet. |
| | v) Others | : Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells |
| 10. | Accessories | : a) Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT (M)] with thermowell connection
b) Compression fittings/unions
c) Flanges etc. (for flanged connections only)
d) Forged/barstock thermowell as per ASME PTC code. Process connection M33X2 (M). |
| | | Material of construction of Thermowell:
SS 316: In general
Inconel: For flue gas application
Tungsten carbide: For coal mill application. |
| 11. | Nameplate | : Tag number, service engraved in stainless steel tag plate |
| 1.09.00 | Pressure Switch | |
| 01. | Type | : i) Piston for high pressure application
ii) Bellow / Diaphragm for low pressure application |
| 02. | Sensing element material | : AISI SS-316. All other wetted part SS316. |
| 03. | Case Material | : Die-cast aluminum alloy, neoprene gasket. |
| 04. | Setter Scale | : Black graduation on white linear scale. Graduation 0-100% with red pointer for set points. |
| 05. | Over range | : 150 % of maximum pressure |
| 06. | Adjustments | : a) Internal Set Point
b) Differential adjustment |
| 07. | End Connection | : 1/2" NPT (M) bottom connected |
| 08. | Switch configuration | : Two SPDT |
| 09. | Switch Rating | : 240V, 5A AC/220V, 0.5A DC |

- | | | | |
|-----|---------------------|---|--|
| 10. | Switch Type | : | Snap acting, shock & vibration proof |
| 11. | Terminal Block | : | Suitable for full ring lugs. |
| 12. | Cable connection | : | ½" NPT conduit connection. |
| 13. | Enclosure Class | : | IP-65. |
| 14. | Performance | : | a) Repeat accuracy $\pm 1.0\%$
b) Accuracy of Setting Indication of $\pm 1.5\%$ |
| 15. | Ambient temperature | : | 0 – 50 Deg.C |
| 16. | Nameplate | : | Tag number, service engraved in SS tag plate |
| 17. | Accessories | : | a) Remote diaphragm seal with SS-316 capillary for viscous & corrosive application.
b) Siphons for steam and hot water services.
c) Retention ring and screws for surface mounting.
d) ½" NPT 2 Valve SS-316 barstock manifold
e) ½" NPT cable gland |
- 1.10.00 Differential Pressure Switch
- | | | | |
|-----|--------------------------|---|---|
| 01. | Type | : | Bellows / Diaphragm / Piston actuated |
| 02. | Sensing element material | : | AISI SS-316. For all other wetted part SS 316 |
| 03. | Case Material | : | Die-cast aluminum alloy with neoprene gasket. |
| 04. | Setter Scale | : | Black graduation on white scale with 0-100% graduation and provided with red pointer for set point adjustment |
| 05. | Over range | : | Static pressure on any one side, the other side being open to atmosphere. |
| 06. | Adjustments | : | a) Internal set point adjustment
b) Differential adjustment |
| 07. | Process Connection | : | ½" NPT (M) bottom / back connected. |
| 08. | Switch configuration | : | Two SPDT |
| 09. | Switch rating | : | 240V, 5A AC/220V, 0.5A DC. |
| 10. | Switch type | : | Snap acting type contacts, shock and vibration proof. |
| 11. | Terminal Blocks | : | Suitable for full ring lugs for cable connection. |
| 12. | Cable Connection | : | ½" NPT conduit connection or compression gland. |
| 13. | Performance | : | a) Repeat accuracy $\pm 1.0\%$
b) Accuracy of set point Indication: $\pm 1.5\%$ |

- | | | | |
|-----|--|---|--|
| 14. | Operating Ambient | : | 0 - 50 °C (Maximum Continuous) |
| 15. | Enclosure | : | IP-65 |
| 16. | Accessories | : | a) Snubbers for pulsating fluid application.
b) Syphons for steam and hot water services.
c) Retention ring and screws for surface mounting.
d) 1/2" NPT 3-Valve SS-316 manifold constructed from barstock
e) 1/2" NPT Cable gland |
| 17. | Nameplate | : | Tag number, service engraved in stainless steel tag plate |
| 18. | Remote Seal type for special application | : | a) Silicone oil / fluorolube filled remote diaphragm seal for dirty / viscous / corrosive fluid.
b) SS armoured capillary at least 3 meters each.
c) Adapter flanges with nuts, bolts and gaskets for instrument and process side. |
- 1.11.00 Level Switch
- | | | | |
|-----|------------------------------|---|---|
| 01. | Type | : | External cage float operated. Magnetically coupled. |
| 02. | Float Material | : | AISI-316 stainless steel or better |
| 03. | Other wetted parts | : | AISI-316 stainless steel or better |
| 04. | External Cage | : | Carbon steel / Stainless steel as per process requirements, welded type / flanged construction. Cage pressure rating shall equal or exceed the rating of the main vessel. |
| 05. | External cage mounting | : | Side-Side. |
| 06. | External cage connection | : | 25 NB socket welded. |
| 07. | Switch housing | : | Epoxy coated die-cast aluminum alloy with neoprene gasket conforming to IP-65. |
| 08. | Type of switch configuration | : | 2 SPDT (two nos.) |
| 09. | Contact rating | : | 5A, 240V/AC, 0.25A, 220V DC |
| 10. | Accessories | : | a) Counter flange, nuts & bolts, suitable gasket etc. |

- | | | |
|---------|--------------------------------|--|
| | | b) Steel globe type drain valve. |
| | | c) ½"NPT cable gland |
| | | d) Stainless steel nameplate with alpha-numeric engraved for service and tag. |
| | 11. Preferred feature | : Switch operating point marked on cage |
| | 12. Mounting | : On standpipe |
| 1.12.00 | Conductivity Type Level Switch | |
| | 01. Type | : Conductivity discrimination. |
| | 02. Application | : Drain pots viz. on CRH line |
| | 03. Mounting | : Flanged – on external cage. |
| | 04. Probe MOC | : Stainless steel with high purity ceramic. |
| | 05. Probe rating | : > Maximum design pressure of vessel. |
| | 06. Input | : Four independent channel with selectable switching threshold for water conductivity. |
| | 07. Relay Output | : Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo. |
| | 08. Contact type & rating | : 2SPDT or 1 DPDT @ 5A 30V DC. |
| | 09. Local Display | : Coloured LEDs for Hi, Lo, Hi-Hi, Lo-Lo, Power & fault. |
| | 10. Power supply | : Dual 240V AC, 50 Hz, 1Ph. |
| | 11. Enclosure | : IP-65, corrosion resistant & wall mounting type (Explosion proof for NEC Class-1, Division-1 area). |
| | 12. Accessories | : a) PTFE cable from probe to electronics
b) Mounting accessories
c) External cage
d) Washer & gasket |
| | 13. Test pressure | : Two times rated pressure |
| | 14. Cable connection | : ½" NPT with cable gland |
| 1.13.00 | Orifice Plate | |
| | 01. Application | : Low fluid velocity flow measurement |
| | 02. Design Standard | : BS-1042, Part-I |
| | 03. Number of Tapings | : As required plus one additional pair of taps |
| | 04. Diameter Ratio | : Between 0.4 to 0.7 |
| | 05. Thickness | : 3 mm for main pipe diameter up to 250 mm, 6 mm for main pipe diameter above 250 mm and 10 mm for main pipe diameter of 500 mm and above. |

- | | | | |
|--|--------------------|---|---|
| 06. | Document | : | Beta ratio calculation, assembly drawing and Flow vs. DP curve. |
| 07. | Meter run pipe | : | Same as pipe material |
| 08. | Accessories | : | Flanges, gaskets, nuts & bolts, root valves jack screw, meter run pipe, Drain & vent hole as per application etc.. |
| 1.14.00 Flow Nozzle | | | |
| 01. | Application | : | High fluid velocity flow measurement |
| 02. | Design Standard | : | ASME PTC 19.5 |
| 03. | Number of Tappings | : | As required plus one additional pair of taps |
| 04. | Diameter Ratio | : | Between 0.4 and 0.7 |
| 05. | Thickness | : | Suitable for the application |
| 06. | Document | : | Beta ratio calculation, assembly drawing and Flow vs. DP curve. |
| 07. | Meter run pipe | : | Same as pipe material |
| 08. | Accessories | : | Meter run pipe, nipples and root valves.
(Inspection port assembly for nozzles used in plant performance purpose) |
| 1.15.00 Gauge Glass | | | |
| 01. | Type | : | Reflex |
| 02. | Glass | : | Toughened borosilicate. Resistant to mechanical and thermal shocks. |
| 03. | Body material | : | Carbon steel / stainless steel- As per process requirements (Flanged Connection) |
| 04. | Pressure rating | : | Twice the maximum working pressure |
| 05. | Temperature rating | : | As required |
| 06. | Bolts and nuts | : | Rust proof alloy steel |
| 07. | Accessories | : | Suitable ball check valves of SS-304/316 body, gaskets, companion flange etc. |
| 1.16.00 Power Cylinders (Pneumatic) | | | |
| 01. | Mounting Type | : | a) Fixed position mounting (End mounting).
b) Trunnion mounting |
| 02. | Control Signal | : | 4-20 mA DC to electro-pneumatic positioner. 24V DC operated solenoid valve operating on pneumatic line for open & closing purpose of on & off drive. |
| 03. | Supply Air | : | 0-7 Kg / Cm ² . |
| 04. | Selection | : | Based upon thrust / torque, stroke length, angular movement, full-scale travel time, repeatability, space factor etc. Provision for air-to-open and air-to-close operation. |

- | | | | |
|---------|----------------------------------|---|--|
| 05. | Casing | : | IP-65. |
| 06. | Accessories | : | a) Air lock relay
b) Hand wheel.
c) Air filter regulator with gauge.
d) Volume Booster.
e) Limit Switches.
f) Positioner with Input and Output pressure gauges, local keypad & display.
g) Solenoid Valve
h) Integral non contact type position Transmitter (4-20 mA DC linear output).
i) Junction box with cable gland |
| 07. | Fail-safe operation | : | For regulating duty- stay put against power & air fail. |
| 08. | Repeatability | : | Better than 0.5% of full travel. |
| 09. | Hysteresis | : | Less than $\pm 1\%$ of full travel |
| 10. | Operating Temp. limit | : | 50 Deg. C (min.) |
| 1.17.00 | Smoke Density Analyzer | | |
| 01. | Type | : | In-situ infra red |
| 02. | Principle of measurement | : | Transmission & absorption (Dual beam type) |
| 03. | Light source | : | Modulated high intensity LED |
| 04. | Display | : | Back Lit LCD |
| 05. | Measurement range | : | 0-999 mg/m ³ , 0-999 mg/Nm ³ , 0-100% opacity |
| 06. | Measurement averaging | : | Selectable 10 sec to 60 minutes |
| 07. | Accuracy | : | 0.2% opacity |
| 08. | Resolution | : | 0.1% opacity |
| 09. | Linearity | : | 0.1% opacity |
| 10. | Repeatability | : | 0.1% opacity |
| 11. | Flue gas temperature | : | 350 °C (max 600 °C) |
| 12. | Ambient temperature | : | 0 - 60 °C |
| 13. | Operating temperature | : | Transmitter & receiver- 0-90°C, Electronic unit - 70 °C |
| 14. | Mounting | : | Transceiver on opposite side of the duct |
| 15. | Analog output | : | 4-20mA DC (in 500 ohm resistance) to |
| 16. | Alarm output | : | 2 SPCO potential free rated at 230 VAC, 5A |
| 17. | Power Supply | : | 240V AC, 50 Hz, 1 Phase |
| 18. | Automatic misalignment detection | : | Required |

- | | | | |
|-----|--|---|---|
| 19. | Automatic compensation of lens contamination | : | Required |
| 20. | Purge air Failure | : | Purge air to be provided from Blower unit and to be monitored for failure. |
| 21. | Span and Zero Check | : | Automatic periodic with manual override |
| 22. | Housing | : | Corrosion resistant painted aluminium rated at IP-65 |
| 23. | Fail safe shutter | : | Automatic fail safe shutter against power and air failure |
| 24. | Input normalisation | : | Correction for temperature, pressure, oxygen and water vapour to be provided. |
| 25. | Preferred Features | : | "Power Supply On" LED visible from front |
| 26. | Accessories | : | a) Mounting pads suitable for mounting projector and receiver units on duct, flanges, etc.
b) Blower unit (Purging System) with purge fail alarm at CCR
c) Enclosure for electronic units & indicators
d) Control unit for interface with PC based data logger |
| 27. | Application | : | At chimney
At each ESP outlet |
- 1.18.00 SO_x, NO_x, CO, CO₂, O₂ & Moisture Analyzer
- | | | | |
|-----|--------------------------|---|--|
| 01. | Type | : | In-situ Probe type combined analyser / Sampling extraction type. |
| 02. | Gases to be measured | : | SO _x , NO _x , CO, CO ₂ , O ₂ and Moisture |
| 03. | Principle of measurement | : | Infrared absorption |
| 04. | Flue gas Temperature | : | 350 °C |
| 05. | Ambient temperature | : | 60 °C |
| 06. | Mounting | : | On chimney |
| 07. | Measurement range | : | 0-3000 ppm / mg/Nm ³ for SO _x , NO _x , CO, O ₂ and 0-25% for CO ₂ and Moisture - fully selectable |
| 08. | Units of measurement | : | PPM, mg / Nm ³ and % |
| 09. | Power Supply | : | 240V, 50 Hz, 1 Phase |
| 10. | Local Display | : | Back lit LCD / LED |
| 11. | Measurement averaging | : | 10 sec to 60minutes (selectable) |
| 12. | Accuracy | : | 2% of measured value |
| 13. | Repeatability | : | 2% of full scale |
| 14. | Response time | : | 5 seconds or better for 95% of full scale |

- | | | | |
|-----|---------------------|---|---|
| 15. | Zero & Span drift | : | 2% per month |
| 16. | Calibration | : | Zero and Span calibration in manual and automatic mode. Automatic calibration interval shall be fully selectable. |
| 17. | Analog output | : | 4-20 mA DC (in 500 ohm resistor) to for each channel |
| 18. | Alarm output | : | 1NO + 1NC rated at 230V AC, 5A |
| 19. | Input normalisation | : | Required—online with pressure and temperature sensor and also provision for key pad entry of inputs |
| 20. | Probe material | : | Stainless Steel 316L |
| 21. | Enclosure | : | Corrosion resistant epoxy painted aluminium housing & enclosure rated to IP-65. |
| 22. | Accessories | : | a) Blower unit, tubes & fittings for calibration and purging, purge fail alarm in CCR

b) Calibration gas cylinders for SO ₂ , NO _x , CO ₂ , O ₂ and CO filled in 10 Ltrs. Of WC carbon cylinder with necessary SS regulators with pressure & flow gauges, solenoid valve & SS tubings and SS fittings etc. as required.

c) Mounting flanges, gasket etc.

d) Control unit for interface with PC based data logger |
| 23. | Application | : | On flue gas stack. |
- 1.19.00 Stack Gas Velocity Monitor
- | | | | |
|-----|--------------------------|---|--|
| 01. | Type | : | Non contact type |
| 02. | Measurement | : | Flue gas velocity |
| 03. | Principle of measurement | : | Time delay correlation of flue gas Infrared emission received by two detectors located at a distance apart on the chimney. |
| 04. | Flue gas Temperature | : | Up to 350 ° C |
| 05. | Ambient temperature | : | 60 ° C |
| 06. | Mounting | : | On chimney |
| 07. | Measurement range | : | As required |
| 08. | Units of measurement | : | velocity- m/sec, flow- m ³ /sec |
| 09. | Power Supply | : | 240V, 50 Hz, 1 Phase |
| 10. | Local Display | : | Back lit LCD / LED |
| 11. | Measurement averaging | : | 10 sec to 60minutes (selectable) |
| 12. | Accuracy | : | 2% of measured value |
| 13. | Linearity | : | 2% of full scale |

	14.	Response time	:	5 seconds or better for 95% of full scale
	15.	Zero & Span drift	:	2% per month
	16.	Calibration	:	Zero and Span adjustment
	17.	Analog output	:	4-20 mA DC (in 500 ohm resistor) to for each channel
	18.	Probe material	:	Stainless Steel 316L
	19.	Enclosure	:	Corrosion resistant epoxy painted aluminium housing & enclosure rated to IP-65.
	20.	Accessories	:	a) Blower unit, tubes & fittings for calibration and purging, purge fail alarm in CCR b) Mounting flanges, gasket etc. c) Control unit for interface with PC based data logger
	21.	Application	:	On chimney
1.20.00		Oxygen Analyzer		
	01.	Type	:	In-situ, Zirconium sensor, micro-processor-based transmitter, field repairable.
	02.	Range	:	0.1-10% / 0.25-25% by volume
	03.	Output	:	4-20 mA DC linear
	04.	Probe Length	:	1800 mm (approximate depending on duct size)
	05.	Process Temperature	:	850 °C approx.
	06.	Measurement Reference	:	Instrument Air
	07.	Accuracy	:	±1% of F.S.
	08.	Response Time	:	Less than 5 (five) seconds
	09.	Amplifier Housing	:	IP-65
	10.	Calibration	:	Automatic periodic
	11.	Calibration Frequency	:	Once every 24 hours
	12.	Power Supply	:	240V, 50 Hz, 1 Phase
	13.	Material for Gas Carrying Components	:	Stainless Steel
	14.	Read Out	:	LED/LCD Local indicating meter
	15.	Protection	:	Automatic cell protection against reducing atmosphere
	16.	Alarm Facility	:	1 HI and 1 LO independently adjustable over span. Contact rating 500 mA at 220 V DC (minimum).
	17.	Preferred Features	:	a) HI and LO alarm LED visible from front. b) Power Supply On/Failure LED visible from front

- | | | | |
|-----|-------------|---|--|
| 18. | Accessories | : | a) Mounting flanges, adaptor plate and protection shield
b) Gasket, nuts and bolts
c) Cable with conduit from cell to amplifier (as required) and other special cables (if any)
d) Automatic calibration kit (complete with all accessories and standard Gas Cylinders) |
| 19. | Application | : | a) At each economizer outlet
b) At each air preheater outlet |
- 1.21.00 CO, NOx & Moisture Analyzer
- | | | | |
|-----|--------------------------|---|---|
| 01. | Type | : | In-situ Probe type combined analyser |
| 02. | Gases to be measured | : | CO, NOx and Moisture |
| 03. | Principle of measurement | : | Infrared absorption |
| 04. | Flue gas Temperature | : | 850 ° C (max) |
| 05. | Ambient temperature | : | 60 ° C |
| 06. | Mounting | : | On duct |
| 07. | Measurement range | : | 0-3000 fully selectable |
| 08. | Units of measurement | : | PPM and mg / Nm ³ |
| 09. | Power Supply | : | 240V, 50 Hz, 1 Phase |
| 10. | Display | : | Back lit LCD / LED |
| 11. | Measurement averaging | : | 10 sec to 60minutes (selectable) |
| 12. | Accuracy | : | 2% of measured value |
| 13. | Repeatability | : | 2% of full scale |
| 14. | Response time | : | 5 seconds or better for 95% of full scale |
| 15. | Zero & Span drift | : | 2% per month |
| 16. | Calibration | : | Zero and Span calibration in manual and automatic mode. Automatic calibration interval shall be fully selectable. |
| 17. | Analog output | : | 4-20 mA DC (in 500 ohm resistor) to for each channel |
| 18. | Alarm output | : | 1NO + 1NC rated at 230V AC, 5A |
| 19. | Input normalisation | : | Required – online with pressure and temperature sensor and also provision for keypad entry of inputs |
| 20. | Probe material | : | Stainless Steel 316L |
| 21. | Enclosure | : | Corrosion resistant epoxy coated aluminium housing & enclosure rated to IP-65. |

- | | | | |
|---------|----------------------------------|---|---|
| 22. | Accessories | : | a) Blower unit, tubes & fittings for calibration and purging, purge fail alarm in CCR |
| | | | b) Calibration gas cylinders for NO _x and CO filled in 10 Ltrs. of WC carbon cylinder with necessary SS regulator, SS gauges, SS tubings and SS fittings etc. as required. |
| | | | c) Mounting flanges, gasket etc. |
| 23. | Application | : | At economizer outlet |
| 1.22.00 | H2 + CO2 + Air Analyzer | | |
| 01. | Type | : | Thermal Conductivity |
| 02. | Range Selection | : | 3 ranges (H ₂ in CO ₂ , H ₂ in air and CO ₂ in air) |
| 03. | Range | : | As required |
| 04. | Output | : | 4-20mA DC (Isolated) |
| 05. | Operating ambient temp. | : | 10 ° C to 50 Deg. C |
| 06. | Power Supply | : | 240V AC, 50Hz |
| 07. | Sample gas flow control | : | Required |
| 08. | Reference gas flow | : | Required |
| 09. | Reference gas pressure regulator | : | Required |
| 10. | Cell response | : | 95% of change in 30 Sec.(Appox.) |
| 11. | Accuracy | : | 2% of full scale |
| 12. | Repeatability | : | 1% of full scale |
| 13. | Local Indicator | : | Indicating meter of 1% accuracy |
| 14. | Alarm facility | : | Dual (High & Low) independently adjustable. |
| 15. | Contact rating | : | 0.5A at 220 V AC |
| 16. | Enclosure | : | Flame Proof |
| 17. | Accessories | : | Calibration gas, mounting accessories and others as required to be provided |
| 18. | Application | : | Generator Gas Purity. |
| 1.23.00 | Radar Type Level Measurement | | |
| 01. | Type | : | Radar based on Time Domain Reflectometry |
| 02. | Antenna | : | Co axial / single rod type guided wave or Horn type as required for the application |
| 03. | Communication | : | Two wire 4-20mA DC, HART or Field Bus protocol. |
| 04. | Environmental temperature | : | 0 – 50 °C |
| 05. | Enclosure | : | Explosion proof /IP 65 as per application |
| 06. | Cable Entry | : | ½" NPT |

- | | | | |
|-----|---------------------------|---|---|
| 07. | Calibration | : | a) Self calibration with internal reference
b) Zero & Span calibration |
| 08. | Programming | : | Handheld programmer & Local keypad |
| 09. | Process Connection | : | Flanged /screwed |
| 10. | Electronic Housing | : | Epoxy painted Die-Cast aluminium alloy |
| 11. | Antenna / Flange assembly | : | 316 SS or Hest alloy (as required) |
| 12. | Output Indicator | : | Digital Integral Display |
| 13. | Accuracy | : | 5 mm or 0.1% of probe length |
| 14. | Accessories | : | a) Programming tool kit
b) Gasket |
- 1.24.00 Temperature Switch
- | | | | |
|-----|--------------------------|---|--|
| 01. | Type | : | Bimetallic or gas filled. |
| 02. | Sensing Element Material | : | Bellow / Bourdon AISI SS-316 |
| 03. | Bulb Material | : | AISI SS-316 |
| 04. | Capillary | : | Stainless steel armored |
| 05. | Movement Material | : | AISI SS-304 |
| 06. | Case material | : | Epoxy coated steel plate or die-cast aluminum alloy with neoprene gasket and clear glass where applicable cover conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area). |
| 07. | Scale | : | Black lettering on white background |
| 08. | Over range Protection | : | 120 % |
| 09. | Instrument connection | : | Bottom |
| 10. | Switch configuration | : | Two SPDT |
| 11. | Switch rating | : | 240V, 5A AC/220V, 0.5A DC |
| 12. | Switch type | : | Snap acting, shock and vibration-proof. |
| 13. | Adjustability | : | Internal Set point adjustable over span range |
| 14. | Cable connection | : | 3/4" ET conduit connection or compression gland. |
| 15. | Compensation | : | a) Capillary compensation with invar wire throughout the capillary length.
b) Case compensation |
| 16. | Performance : | | |
| | i) Scale Accuracy | : | ±1.0 % of full scale |
| | i) Repeatability | : | < 0.5 % of full range |
| | ii) Response time | : | Less than 40 seconds with thermowell |
| 17. | Capillary length | : | 5 meters (minimum) for local mounting/15 meters for local panel mounting. |

	18. Nameplate	:	Tag number, service engraved in stainless steel tag plate
	19. Accessories	:	Mounting accessories, 3/4"ET cable gland.
1.25.00	Rotameter		
	01. Type	:	On-line up to 2". By-pass above 2"
	02. Metering tube	:	Borosilicate glass
	03. Float	:	AISI 316-SS unless the process fluid demands some other material.
	04. Body MOC	:	AISI 316-SS
	05. Scale	:	Graduated- Engraved black on white background.
	06. Process connection	:	Flanged
	07. Accuracy	:	± 2% of full scale detection or better for on-line type and ±4% of full-scale detection or better for by-pass type.
	08. Nameplate	:	Tag number, service engraved in stainless steel tag plate
	09. Accessories	:	Slip-on orifice plate of 316-SS and taps of Stainless Steel as per application requirements. Applicable SS Isolation valves and SS Range Orifice - for bypass type rotameters.
1.26.00	I/P Converter		
	01. Type	:	Electro-pneumatic (Outdoor Type)
	02. Input level	:	4-20 mA DC
	03. Output range	:	0.2 to 1.0 Kg/Sq. cm With 'Fail Freeze' feature. (i.e in case of wire snapping the last good value of pneumatic signal out put will hold for at least six hours)
	04. Split range	:	For typical application wherever required.
	05. Control Action	:	Selectable air to close, air to open and fail freeze application
	06. Supply pressure	:	1.2 to 1.6 Kg/cm ² (1.4 typical)
	07. Max. supply pressure	:	7 Kg/ sq.cm.
	08. Response Time	:	5 Seconds for 0 to 90% output pressure
	09. Housing	:	IP 55
	10. Repeatability	:	±0.1% of span
	11. Accuracy	:	± 0.25% of span
	12. Supply pressure effect	:	Less than 1%
	13. Span and Zero adjustments	:	Screw
	14. Pneumatic connection	:	1/4" NPT

	15. Stability	: Less than 0.25% of Span / Zero for six months.
	16. Cable connection	: ¾" ET
	17. Mounting	: Field (pipe/wall mounting)
	18. Accessories	: Air filter regulator, mounting accessories, cable gland etc.
1.27.00	Air Filter Regulator	
	01. Filter Element	: Sintered Bronze
	02. Filter Size	: 5 microns
	03. Input Air	: 10.0 Kg/Sq. cm (maximum)
	04. Output	: Adjustable from 0-2.0 Kg / Sq. cm or 0-7.0 Kg / Sq. cm (continuous) as applicable for I/P converter, control drives and control valve
	05. Effect of Supply	: Maximum 0.02 Kg/Sq. cm for a change pressure variation in supply pressure of 4 Kg/Sq. cm
	06. Bowl Material	: Metallic cover around high temperature area / clear transparent polycarbonate with metallic cover for ordinary applications.
	07. Accessories	: 2" dial size output pressure gauge
	08. Desirable Feature	: No perceptible drop of pressure on opening the drain port.
1.28.00	Solenoid Valve	
	01. Operating Principle	: Electromagnetic (noiseless)
	02. Coil voltage rating	: 240 V AC / 220 V DC/24 V DC/110 V (as required)
	03. Ways	: Generally 3-ways other depending on requirement
	04. Port size	: 1/4" NPT all ports
	05. Body	: SS bar stock
	06. Trim	: SS-316
	07. Duty	: Suitable for continuous energization
	08. Sealing	: Airtight and leak proof
	09. Ambient Temperature	: 0 - 50 ° C
	10. Fluid Temperature	: 0-150 ° C (approx.)
	11. Coil Enclosure	: Stainless Steel
	12. Insulation	: Class-H
	13. Coil Casing	: IP-65 (Explosion proof for NEC Class-1, Division-1 area)
	14. Mounting	: On pipe or on panel
	15. Cable Connection	: 3/4" ET
	16. Accessories	: Mounting brackets, nuts and bolts

- | | | | |
|-----|-------------------|---|--|
| 17. | Preferred feature | : | a) Solenoid valve directly integral to actuator body shall have NAMOOR interface for uniformity
b) Local indication for power |
|-----|-------------------|---|--|
- 1.29.00 Sight Glass
- | | | | |
|-----|-------------------------|---|------------------------------------|
| 01. | Type | : | Flap-type |
| 02. | End connection | : | Screwed / Flanged |
| 03. | Material: | | |
| | a) Body | : | CS/SS as per process medium |
| | b) Indicator | : | Stainless steel |
| 04. | Sight Glass | : | Toughened Borosilicate |
| 05. | Gasket | : | Neoprene |
| 06. | Bolts & Nuts | : | High tensile steel |
| 07. | Hydraulic Test Pressure | : | 1.5 times maximum working pressure |
| 08. | Accessories | : | As required |
- 1.30.00 Flow Indicating Switch
- | | | | |
|-----|------------------------|---|---|
| 01. | Type | : | On line metal tube Rotameter |
| 02. | End connection | : | Flanged |
| 03. | Material: | | |
| | a) Body | : | CS/SS as per process medium |
| | b) Float | : | Stainless steel |
| | c) End fittings/flange | : | Stainless steel |
| | d) Other wetted part | : | Stainless steel |
| | b) Casing | : | Di cast Alluminium |
| 04. | Accuracy | : | +/- 2.0% of FSR |
| 05. | Rangeability | : | 10:1 |
| 06. | Electrical connection | : | ¾" ET |
| 07. | Switch type | : | Snap acting hermitically sealed 2 nos. SPDT |
| 08. | Contact rating | : | 5A, 240V AC |
| 09. | Protection class | : | IP-65 |
| 10. | Accessories | : | As required |
- 2.00.00 **CLOSED CIRCUIT TELEVISION SYSTEM**
- 2.01.00 Closed Circuit Television System
- 2.01.01 Closed Circuit Television System (CCTV) with all equipment and accessories shall be installed for the purpose of surveillance of major plant areas. Also, cameras shall be installed at the Main plant (TG Hall, Boiler ESP) and other common auxiliary plants.
- 2.01.02 The CCTV system shall meet the specific functional & design requirements towards collecting live video information from the various areas of the plant and displaying that information at monitors.

- 2.01.03 Bidder shall include Digital Server based Video Manager, Camera unit, Video Streamer, Optical fiber network cables, Network hard wares & all other accessories including design / engineering, testing, erection & commissioning etc. for complete functioning of the system.
- 2.01.04 Bidder shall consider licensed version of all application and system software required for the system.
- 2.01.05 System shall be of proven design in dust laden atmosphere and of reputed make.
- 2.01.06 Bidder shall submit block schematic of Power distribution and wiring diagram, CCTV network architecture drawing, hardware & software detail and other information as necessary.
- 2.01.07 Requirement for minimum number of camera units and their tentative locations are listed below. CCTV system shall include industrially ruggedized high resolution colour day/night CCD camera, motorized zoom lenses, PAN & TILT mechanism, Transmitter / Receiver units & video Streamer integrated to a Digital Video Management Server for video switching, control and recording functions.

LIST OF CAMERAS TO BE PROVIDED

SL. No.	TYPE OF CAMERA	ENCLOSURE CLASS	LOCATION	NO. OF CAMERAS PER UNIT
1.	CCD camera (Dome Type)	IP 54	TG Hall	01
2.	CCD camera	IP 54	TG Hall	02
3.	CCD camera	IP 54	Turbine oil room	01
4.	CCD camera	IP 54	Boiler Feed Pumps	03
5.	CCD camera	IP 54	Condensate Extraction Pumps	01
6.	CCD camera	IP 54	Generator seal oil system	01
7.	CCD camera	IP 54	Compressor room	01
8.	CCD camera	IP 54	Switchgear Room	01
9.	CCD camera	IP 65	Boiler Firing Floor	01
10.	CCD camera	IP 54	Boiler circulation water pumps	02

SL. No.	TYPE OF CAMERA	ENCLOSURE CLASS	LOCATION	NO. OF CAMERAS PER UNIT
11.	CCD camera	IP 65	Coal mill area	06
12.	CCD camera	IP 65	Coal Feeder area	06
13.	CCD camera	IP 65	ID Fan	02
14.	CCD camera	IP 65	FD Fan	02
15.	CCD camera	IP 65	PA Fan	02
16.	CCD camera	IP 54	AHP control room	01
17.	CCD camera	IP 65	Ash water pump house	01
18.	CCD camera	IP 65	Air heater area	01
19.	CCD camera	IP 65	ESP field area	02
20.	CCD camera	IP 65	Generator Transformer Bay	02
21.	CCD camera	IP 65	To be decided during detailed	04

LIST OF CAMERAS TO BE PROVIDED AT COMMON PLANT AREA

SL. No.	TYPE OF CAMERA(DOME TYPE)	ENCLOSURE CLASS	LOCATION	NO. OF CAMERAS
1.	CCD camera	IP 65	Ash slurry Pump House area	02
2.	CCD camera	IP 65	CW Pumps	02
3.	CCD camera	IP 65	ACW Pumps	01
4.	CCD camera	IP 65	Fire Water Pump House	01
5.	CCD camera	IP 65	Fuel oil Pressurizing	01

SL. No.	TYPE OF CAMERA(DOME TYPE)	ENCLOSURE CLASS	LOCATION	No. OF CAMERAS
			Pump House	
6.	CCD camera	IP 65	Fuel oil unloading bay	02
7.	CCD camera	IP 65	Fuel oil unloading pump house	01
8.	CCD camera	IP 65	Fuel oil tank area	01
9.	CCD camera	IP 65	Unloading Bay of Unit	01
10.	CCD camera	IP 65	CHP area	08
11.	CCD camera	IP 65	Switchyard	01
12.	CCD camera	IP 65	DM plant	01
13.	CCD camera	IP 65	Chimney	01
14.	CCD camera	IP 65	Cooling Tower	01
15.	CCD camera	IP 65	ETP plant	01
16.	CCD camera	IP 65	Cable gallery	05
17.	CCD camera	IP 54	CCR	01
18.	CCD camera	IP 54	Control equipment room	01

2.01.08 CCTV system shall be powered from UPS.

2.01.09 System shall be time synchronized with the GPS master clock.

2.01.10 Design and Technical Requirements

- a) CCTV system envisaged shall have a Primary Digital Video Server along with Four (4) off Secondary Digital Video Servers, one for each unit and one for common area. The prime application program shall reside at Primary Digital Video Server and shall interface Secondary Digital Video Servers & Cameras for video and audio switching and

- control of the system. The Primary Server shall have the capability to add future secondary servers to support future expansion.
- b) 2 (two) 24" TFT monitoring stations shall be provided for monitoring of the plant. The system elements shall be able to communicate on Ethernet network.
- c) System shall store alarm and event activated recording. Features shall be provided only to capture most needed videos. It shall also have pre-recording feature so that videos prior to the event occurring can also be stored. The system operation shall cover the complete view of the areas by control of pan, tilt & zoom of the cameras. Modification of the system parameters shall be possible from any of the above stations.
- d) The system shall have following minimum controlling capability:
- PTZ control with Iris level control, pre-positioning control for at least 128 cameras.
 - Simultaneously record and play back input from up to 128 cameras.
 - Both manual and automatic mode control.
- e) The system shall have capability not limited to the followings :
- It shall be possible to view live video from anywhere on the network, including over wide area network connections, through firewalls & routers. The live output from cameras shall be viewed through a series of displays.
 - Sequence view of camera preset position.
 - Modifying settings/ record settings for a camera
 - Adding and deleting camera from the system.
 - Creating schedules for recording on video motion detection
 - Video recording with features like Operator Activated Recordings, Alarm and Event Activated Recordings, Scheduled Recordings (including 24hr recording), Video Motion Detection & Recordings and Exporting of a Recorded video into Microsoft Windows Media Format file.
 - Video Server shall have video recorder with sufficient disk space for on-line video storage and access to archiving mechanisms for the removal of stored video to off-line media. Event shall be stored in the recorder at least for 30 days. Recorder shall have date & time search and can playback of recorded video.
 - Archiving of the recorded videos to archiving media like DVD.
 - Video features like Single camera viewing, Quad viewing and Sequence viewing.
 - Pass word protected Security levels for the monitoring and control of cameras to authorised users.

The system should be completely compatible to be integrated to Fire Alarm System. When the fire is detected by a particular detector the camera

assigned should automatically focus the site of the fire. For implementation of the same, 24 nos. potential free input contacts per unit and 24 nos. potential free input contacts for common plant area shall be provided for Fire Detection system interfacing with CCTV system panel. Proper implementation of the same shall be in the scope of bidder.

2.01.11 Description of System Components

CCTV Management system for the plant shall be built upon industry-standard TCP/IP open networking. The components shall be public domain products. Bidder shall furnish latest proven model of components & accessories, not limited to the following, for completeness of the system.

a) Primary Digital Video Server

- Request and receive live video from the streamers and the cameras.
- Multicast or Unicast live video.
- Receive camera control commands and send to the cameras.
- Store live video (recordings) into hard drives.
- Transmit previously stored video recordings to monitors when requested.
- Record video on request.
- Record video upon alarm trigger.
- Schedule recordings and video motion detection
- Provide search engines for recordings
- Archive previously stored video to off-line storage media
- Retrieve archived video from off-line storage media
- Recording of both video and audio simultaneously for 128 channels.
- Recording 18~24 frames/ second regardless of the number of streams.
- Report any camera failure or recording failure
- Time synchronization with the plant GPS.

b) Secondary Digital Video Servers

Features of the server shall not be limited to the following :

- i) Limit and grant operator access to live and recorded video and audio.
- ii) Send request to video server to record video and audio
- iii) Provide indication of any camera which has failed
- iv) Configure PTZ access
- v) Configure alarm and alarm access
- vi) System configuration
- vii) Video transmitter and receiver configuration

c) Server configuration

The specification shall be as below or the latest available at the market at the time of contract.

SL. NO.	FEATURE	REQUIRED PARAMETER
1.	Operating system	Windows 2000 or latest version
2	Code Compression	To be specified by Bidder
2.	Processor	Intel Xeon 2.4 Ghz or better
4.	RAM	1 GB RAM
5.	Hard disk	5 x 60GB SCSI (minimum) with provision for future
6.	CD ROM Drive	52 X or better
7.	DVD writer	CD Read & write DVD Read & write
8.	Video output	SXGA
9.	Remote Control	Full control Via TCP/IP
10.	DAT Drive	Ultrium back up drive with tape auto loader
11.	Monitor	22" Colour LCD.
12.	Input voltage	240 V AC 50 Hz
13.	Mounting	19" rack mounting
14.	Additional software for the Primary / Secondary server.	Microsoft SQL Server 2000 including Digital Video

d) Cameras

The cameras shall be rugged 1/3 inch image format or better, full performance color CCD cameras. For Dome type camera imager may be 1/4" size. Cameras shall provide high resolution and high sensitivity , both in natural and artificially sighted areas. Features shall not be limited to the followings:

- i) Suitable for day & night time surveillance.
- ii) Manual or Automatic colour / infrared switching.
- iii) Automatic picture enhancement to give a balanced picture in too little / too much light.
- iv) Remote camera setup, with on screen menu display.
- v) Character generator giving up to 24 character text-in-pictures.
- vi) Backlight composition.
- vii) Automatic white balance, with mode selection options.
- viii) Contour correction and contrast compression control.

Technical requirements shall not be limited to the following :

- *COLOUR CCD CAMERA*

SL. No.	FEATURE	REQUIRED PARAMETERS
1.	Imager	1/3" Color CCD
2.	Effective Pixels	752 (H) x 582 (V) PAL
3.	Television System	PAL
4.	Horizontal resolution	540 lines
5.	Focus / Iris	Automatic with manual override
6.	Min. illumination	Color- 0.3lux – 0.002 lux
7.	Lens Mount	CS/C with lens washer
8.	Aperture correction	Horizontal and vertical
9.	Shutter Speed	MFR standard
10.	Signal to Noise Ratio	More than 52dB
11.	Gain control	Automatic
12.	White Balance	2000K to 10000K
13.	BLC	On / Off switch
14.	Video Output	1.0V Pk-Pk, 75 Ohm
15.	Power Supply	AC 240V, 1Ph. 50Hz
16.	Operating Temperature	-10 ⁰ ~ 50 ⁰ C
17.	Humidity	0-100%

SL. NO.	FEATURE	REQUIRED PARAMETERS
18.	Accessories	i) Outdoor type box for Power supply unit and fiber optic connectivity. ii) Mounting accessories iii) PAN and TILT mechanism iv) Camera housing
19.	Preferred Certification	CE, FCC

• *DOME COLOUR CCD CAMERA*

SL. NO.	FEATURE	REQUIRED PARAMETERS
1.	Imager	1/4" Color CCD
2.	Effective Pixels	752 (H) x 582 (V)
3.	Television System	PAL
4.	Sync. system	Internal / External
5.	Horizontal resolution	460 TV Lines
6.	Focus	Automatic with manual override
7.	Iris	Automatic with manual override
8.	Field of view	2.7 Deg. to 48 Deg.
9.	Sensitivity	For day & night surveillance 0.0005 lux in night mode slow shutter on 0.031 lux in night mode slow shutter off 0.0033 lux in day mode slow shutter on 0.25 lux in day mode slow shutter off
10.	Aperture correction	Horizontal and vertical
11.	Optical & digital Zoom	12X
12.	Signal to Noise Ratio	More than 50dB
13.	Gain control	Off/automatic

SL. No.	FEATURE	REQUIRED PARAMETERS
14	White Balance	2000K to 10000K
15	BLC	On / Off switch
16	Video Output	1.0V Pk-Pk, 75 Ohm
17	Power Source	AC 240V, 1Ph. 50Hz
18	Operating Temperature	-10 ⁰ ~ 50 ⁰ C
19	Humidity	0-100%
20	Accessories	i) Outdoor type box for Power supply unit and fiber optic connectivity. ii) Mounting accessories iii) PAN and TILT mechanism iv) Camera housing
21	Preferred Certification	CE, FCC
e)	Lens	The lens shall be minimum Auto-iris lens of 1/3 inch. with zooms facility. Depending upon the system requirements bidder shall provide the exact zoom lens.
i)	LENS (Zoom Lens of 6-60mm)	
Sl. No.	Feature	Required Parameters
1.	Zoom	6-60 mm (10 X)
2.	Lower focal distance	6 mm
3.	Size	1/3" format
4.	Iris	Auto-video drive

Sl. No.	Feature	Required Parameters
5.	Pre-set	Focus, Zoom
6.	Zoom Control	Motorized
7.	Focus Control	Motorized
8.	Connector to camera	“C” or “CS”
9.	Iris control	Motorized and /or automatic
ii) LENS (Zoom Lens of 8--120mm)		
Sl no.	Feature	Required Parameters
1.	Zoom	8-120 mm (15 X)
2.	Lower focal distance	8 mm
3.	Size	1/3” format
4.	Iris	Auto-video drive
5.	Pre-set	Focus, Zoom and/or automatic
6.	Zoom Control	Motorized
7.	Focus Control	Motorized
8.	Connector to camera	“C” or “CS”
9.	Iris control	Motorized and /or automatic
10.	Interchangeability	From same make with interchangeability / compatibility with associated accessories.

f) Camera Housing

All the cameras and accessories shall be housed in Weather proof environmental cases of aluminum.

The housing should also have thermostatically controlled heater kit, continuous duty blower kit, purge air arrangement, Window wipers etc. Features available shall be as follows :

SL. No.	FEATURE	REQUIRED PARAMETER
1.	Construction Material	Extruded and die cast aluminum
2.	Protection Degree	IP65

SL. No.	FEATURE	REQUIRED PARAMETER
3.	View window material	Fully tempered plate glass of 0.5" thick
4.	Finish	Grey Polyester Powder coated
5.	Accessories	Thermostatic heater, Defroster, Blower and sun shroud & Should have provision for washer and wiper for the dust prone areas.
6.	Input Voltage	240V AC
7.	Camera compatibility	Enclosure dimension should provide sufficient space to house the offered camera and lens assembly.
8.	Cabling (Housing with P/T)	Internal, through Pan /Tilt assembly.
9.	Cabling (Fixed Housing)	Two entries for cabling with compression gland
10.	Camera Mount	Removable with Sleds
11.	Certification	UL/CE

g) Pan & Tilt Unit :

The Pan & Tilt unit should be weather proof (IP-55) type and designed to meet harsh environment and should be constructed with corrosion resistant hardware and with 100% duty cycle motors to permit continuous operation.

Features available shall be as follows :

SL. No.	FEATURE	REQUIRED PARAMETER
1.	Pan Range	0-355 Degrees
2.	Pan Speed	7 degree / Second or better
3.	Tilt Range	$\pm 90^0$ (in vertical plane)
4.	Tilt Speed	3 Degrees /second or better
5.	Duty cycle	50%, 30 minute rating
6.	Connectors	Cables /glands to be supplied with P/T unit.
7.	Construction	Aluminum plate. Internal & external parts corrosion resistant.

SL. No.	FEATURE	REQUIRED PARAMETER
8.	Presets	Should be available
9.	Limit Switches	Internally adjustable
10.	Input Power	24V AC, 50 Hz
11.	Operating Temperature	0 to 50 degree centigrade
12.	Certifications	UL/CE

h) On-site Receiver/Driver Unit :

The on-site receiver/drive unit should be able to control the motor drives for pan/tilt and cameras for zoom and aux control. These would be used in conjunction with the Camera Streamer systems. Features available shall be as follows :

SL. No.	FEATURE	REQUIRED PARAMETER
1.	Input/Output Signal	RS-422 or RS 232 or RS 485.
2.	Pre-sets	Minimum 64
3.	Output	Pan, Tilt, Focus, Zoom, Wipe, Wash.
4.	Output voltages	As required by lens and PTZ unit
5.	Diagnostics	Built in should be available
6.	Up Gradability	Should operate with any industry standard PTZ units
7.	Testing of Pan/Tilt functions	On site testing should be available
8.	Housing	Should be housed in weather proof or explosion proof housing as per locations.
9.	Input Voltage	240 Volts AC, 50 Hz.
10.	Operating Temperature	0-50 Degrees centigrade
11.	Humidity	95%
12.	Certifications	CE/UL

i) Video Streamers

Industry standard commercial video streamers to perform the following functions shall be used:

- Convert the analog camera video signal into a digital format
- Stream the digital video onto the Ethernet network
- Receives camera control commands from Digital Video Server and send these commands to the camera PTZ head using a serial connection.

SL. No.	FEATURE	REQUIRED PARAMETER
1.	Video Input	1 input, 1V pp, 75 ohms, PAL
2.	Serial Port	RS 232 or RS422 or RS 485
3.	Video compression	MPEG. H.263
4.	Protocols	TCP / IP, UDP / IP, IGMP (Multicast) DHCP Client, HTTP.
5.	Regulatory	EN55022,EN55024
6.	Input/output ports	RJ 45 for 10/100 Mbps, RS 232/422/485 port. 4 opto isolated general inputs and 1 relay output. 1 video input (BNC) & 1 video output (BNC)
7.	Resolution	704 x 576 (Single high resolution), 352 x 250(Standard Size) or better
8.	Video through put	Upto 25 fps or better
9.	Bit rate	User configurable bit rates from 8 Kbps to 2 Mbps. It should be able to send CIF size video at 18 ~24 fps at 400 Kbps.
10.	Decoder	The Encoder should be usable as a decoder to give output to an analogue CCTV monitor if required.
11.	Operating Temperature	0 to 50 degrees centigrade.
12.	Input Power	240 V AC, 50 Hz.
13.	Housing	Should be housed in dust & weather proof housing as per locations.

j) Network Infrastructure & Cable

CCTV network configuration shall be built on the Stackable Managed Ethernet switches for better control of data traffic & performance and future expansion. Switch configuration shall be redundant with seamless changeover without any upset in the CCTV operation. MTBF of the switch shall be more than 20 Years. Configuration shall be automatic.

3.00.00 CONTROL PANEL/DESK MOUNTED INSTRUMENTS AND ELECTRICAL SYSTEM ACCESSORIES

3.01.00 Coupling Relay

- | | | |
|---------------------|---|--|
| 01. Type | : | Octal base plug-in type/ DIN rail Mounting |
| 02. Coil voltage | : | 24 V D.C. in general / other as required |
| 03. Contact | : | 2 NO & 2 NC (Minimum) |
| 04. Contact rating | : | 250 V/5A (A.C)/220V/2A (D.C) |
| 05. Operating range | : | 70 to 110% of rated voltage. |
| 06. Insulation | : | 2 KV for 1 minutes between terminal & earth. |
| 07. Mechanical life | : | 20 million operations |
| 08. Coil protection | : | Diode |
| 09. Indication | : | Coil on LED |
| 10. Enclosure | : | Transparent cover |
| 11. Connection | : | Screw terminals. |
| 12. Mounting | : | Projection mounting inside panel / DIN rail mounting |

3.02.00 Bar graph Indicator

- | | | |
|-----------------------------|---|---|
| 01. Type | : | Bar graph |
| 02. Number of channels | : | One / Two (as required) |
| 03. Input | : | 4-20 mA/1-5 V/Thermocouple/RTD |
| 04. Indication | : | Green LED / LCD |
| 05. Scale | : | 100 mm vertical one for each channel graduated in engineering unit (linear scale) |
| 06. Readable Distance | : | 3 meters (minimum) |
| 07. Mounting | : | Flush panel |
| 08. Face Dimension | : | 36(W) x 144(H) mm (approx) / 72 x 144 (H) mm |
| 09. Resolution | : | 1% of scale or better |
| 10. Power Supply | : | 240V, 1 Phase, 50 Hz AC |
| 11. Operating Conditions :- | | |
| a) Temperature | : | 0-50 ° C |
| b) Relative Humidity | : | 5%-95% |
| c) Supply Voltage | : | -15% to +10% |
| 12. Connection between | | |

	Indicator and Tray	:	Prefab Cable
13.	Accessories	:	i) Mounting Tray ii) Engraved phenolic nameplate affixed to front flange to identify each indicator by tag number and each point by measured variables.
14.	Alarm Facility	:	1 HI and 1 LO for each channel independently adjustable over span. Voltage free outputs
15.	Reference Junction Compensation	:	Built-in cold junction compensation for thermocouple inputs
16.	Feature	:	i) Alarm level indication by flashing cursor ii) Green Digital display of parameter value in front panel with a 3.1/2 digit display.
3.03.00	Valve Position Indicator		
01.	Input	:	4-20 mA DC/1-5 Volts DC
02.	Indication	:	Pointer and Scale. Moving Coil Meter
03.	Readable Distance	:	3 meters (minimum)
04.	Pointer Deflection	:	90 Deg Sector or linear
05.	Mounting	:	Flush Panel (Horizontal/vertical)
06.	Accuracy	:	±1% or better
07.	Protection Class	:	IP-42
08.	Operating Ambient Temp.	:	0-50 °C
09.	Scale	:	0-100%
10.	Bezel Size	:	DIN Standard
3.04.00	Digital Indicator		
01.	Type	:	Four and half digit LED seven-segment display with sign.
02.	Face Dimension	:	72 x 144 mm / 48 x 96 mm (as applicable)
03.	Display Character	:	13.8 mm, Green (LED)
04.	Accuracy	:	0.1% of reading, ±2 digit
05.	Input	:	4-20mA DC/1-5 V DC/RTD/Thermocouple
06.	Mounting	:	Flush Panel
07.	Power Supply	:	240V ±10%, 50 ±2.5 Hz
08.	Output Contact	:	2 nos SPDT, contact rating 5A at 240V AC/ 0.25A at 220V DC
09.	Power/Signal Connection	:	Screwed
	Large Display (150x300 mm) indicators shall be provided for MW, MVAR and frequency indications.		

3.05.00 Push Button

- | | | | |
|-----|-----------------------|---|--|
| 01. | Type | : | Shrouded square format |
| 02. | Face Dimension | : | 32 x 32 mm (maximum) |
| 03. | Contact Configuration | : | 2 NO + 2 NC |
| 04. | Contact Addition | : | Add-on block up to 4 each with 2 pairs of contacts |
| 05. | Contact Material | : | Hard Silver Alloy |
| 06. | Contact Rating | : | 500V / 10 A |
| 07. | Utilization Category | : | AC11 / DC11 |
| 08. | Insulation Voltage | : | 2 KV for 1 minute between terminals and earth |
| 09. | Mechanical Life | : | 1 million operation |
| 10. | Construction | : | Aluminum shrouding with plastic lens |
| 11. | Colors | : | Red, Green, Yellow, Black, etc. |
| 12. | Connection | : | Screw terminals |
| 13. | Enclosure Class | : | IP-52 |
| 14. | Legend | : | Engraving |

3.06.00 Illuminated Push Button

- | | | | |
|-----|-----------------------|---|--|
| 01. | Type | : | Square format |
| 02. | Face Dimension | : | 32 x 32 mm (maximum) |
| 03. | Contact Configuration | : | 2 NO + 2 NC (minimum) |
| 04. | Contact Addition | : | Add-on-Block up to 4 each with 2 pairs of contacts |
| 05. | Contact Material | : | Hard Silver Alloy |
| 06. | Contact Rating | : | 500 V/ 10A |
| 07. | Utilization Category | : | A C11 / DC11 |
| 08. | Insulation Voltage | : | 2 KV for 1 minute between terminals and earth |
| 09. | Mechanical Life | : | 1 Million Operation |
| 10. | Lamp | : | LED with built-in resistors as required |
| 11. | Lamp Rating :- | | |
| | a) Voltage | : | 240 V AC |
| | b) Watt | : | 2 Watt (approx.) |
| 12. | Lamp and Lens | | |
| | Replacement | : | From front |
| 13. | Construction | : | Transparent Plastic Lens |
| 14. | Color | : | Red, Green, Amber, Yellow etc. |
| 15. | Connection | : | Screw terminals |

	16. Enclosure Class	:	IP-52
	17. Legend	:	Engraving
3.07.00	Selector Switch		
	01. Type	:	2/3/4 position stay put type with rotary lever actuator.
	02. Face Dimension	:	32 x 32 mm (maximum)
	03. Contact Configuration	:	4 pair of contacts
	04. Contact Addition	:	Add-on-Block up to 4 each with 2 pairs of contact
	05. Contact Material	:	Hard silver Alloy
	06. Contact Rating	:	500 V/10 A
	07. Utilization Category	:	AC11 / DC11
	08. Insulation Voltage	:	2 KV for 1 minute between terminals and earth
	09. Mechanical Life	:	1 million operation
	10. Construction	:	Aluminum shrouding
	11. Connection	:	Screw terminals
	12. Enclosure Class	:	IP-52
3.08.00	Indicating Lamp		
	01. Type	:	LED with built-in resistor
	02. Face Dimension	:	32 x 32 mm (maximum)
	03. Voltage	:	240 V AC
	04. Watt	:	2.5 Watt (approximate)
	05. Lamp and Lens Replacement	:	From front
	06. Construction	:	Transparent Plastic lens
	07. Color	:	Red, Green, Amber, Yellow etc.
	08. Connection	:	Screw terminals
	09. Legend	:	Engraving
3.09.00	Indicating Meters (A.C)		
	01. Type	:	Rectifier type
	02. Face Dimension	:	96 x 96 mm
	03. Scale	:	Radial arc of 240 Deg.
	04. Accuracy	:	1.5% of full scale. ±0.5 Hz for frequency meter
	05. Input	:	0-1/0-5A for current measurement, 0-240V, 50 ± 2.5 Hz for voltage / frequency measurement
	06. Zero Adjustment	:	Screw on meter face

- | | | | |
|-----|-----------------------|---|---|
| 07. | Enclosure | : | Shielded Case |
| 08. | Mounting | : | Flush Panel |
| 09. | End Scale Suppression | : | 6 times the measuring range only for motor ammeters |

3.10.00 Indicating Meters (D.C)

- | | | | |
|-----|-----------------------|---|--|
| 01. | Type | : | Taut band moving coil |
| 02. | Face Dimension | : | 96 x 96 mm |
| 03. | Scale | : | Radial arc of 240 Deg. |
| 04. | Accuracy | : | 1.5% of full scale |
| 05. | Input | : | 0-75 mA for current measurement. Direct reading for voltage measurement. |
| 06. | Zero Adjustment | : | Screw on meter face |
| 07. | Enclosure | : | Shielded case |
| 08. | Mounting | : | Flush Panel |
| 09. | End Scale Suppression | : | 2 times the measuring range only for motor ammeters. |

For electrical system's meter and for synchronization, Bidder shall refer to electrical volume of the specification

3.11.00 Auxiliary Relay

- | | | | |
|-----|-----------------------|---|---|
| 01. | Type | : | Electromagnetic |
| 02. | Coil voltage | : | 240 V A.C / 220V DC. For any other voltage bidder to make his own arrangement. |
| 03. | Contact Configuration | : | 2 NO & 2 NC (Minimum), additional contacts as per requirement with provision for additional contact block expansion |
| 04. | Contact rating | : | 250V/5A (A.C/D.C.) |
| 05. | Operating range | : | 80 to 110% of rated voltage |
| 06. | Insulation | : | 2 KV for 1 minute between terminals & earth. |
| 07. | Mechanical life | : | 20 million operations |
| 08. | Coil protection | : | Diode/surge suppressor |
| 09. | Connection | : | Screw terminals. |
| 10. | Mounting | : | Projection mounting inside panel |

3.12.00 Electrical Transducer

Transducers shall be provided for conversion of AC electrical quantities such as voltage, current and power. Transducer shall be suitable for 220V DC auxiliary supply. Transducers shall be of low burden type having 4 – 20 mA DC linear galvanically isolated output compatible with secondary indicating instrument. Transducer shall be dual channel type. Accuracy class of Transducers shall be as per IS14570:1998 or IEC688:992

3.13.00 Synchroscope

Synchroscope shall be designed to provide an illuminate and indication of phase and frequency difference between bus voltage and Generator voltage. It shall denote the actual frequency difference corresponding to the inverse of time taken for one rotation of the illuminated vector spot. The instrument shall be designed for industrial applications, which require precise, reliable and robust instruments for the display range and indication. Synchroscope shall be designed as per the DIN / IEC / BS standards.

4.00.00 ~~CONTROL VALVES, ACTUATORS & ACCESSORIES~~

~~General Technical Guidelines for the Control Valves shall be as follows :~~

- ~~a) Bidder shall exercise caution in selecting severe service control valves like BFP recirculation valves, HP & LP bypass valves, superheater & reheater attemperator valves, PRDS valves for Boiler & Turbine, Soot blower steam pressure control valve, control valves whose down stream are connected to vacuum such as HP/LP heater emergency level control, condenser make up water control valve, separator level control and CEP minimum flow control valve. For such critical applications, Bidder shall offer valves which are proven for similar application. Above valves shall have leakage class equal or better than class V with metal to metal seating.~~
- ~~b) Wherever, steam conditioning calls for Pressure reducing & desuperheating, combined PRDS type valves shall be offered.~~
- ~~c) Bidder shall provide redundant control valves for Main condensate flow control, Superheat attemperation control and Reheat attemperation control as a minimum for high availability. For other application, if the availability criteria for the plant cannot be met even with the best established product, redundant control valves shall be provided.~~
- ~~d) Control valves shall be located near floor or platform for ease of access and with adequate clearances for maintenance and lay down and shall be placed as station with upstream motorized isolating valve, down stream isolating valve, inching duty motorized bypass valve and manual drain valves. Each redundant control valve shall have its upstream motorized and down stream manual isolating valves. Where quick shut off requirement is foreseen such as in case of SH & RH attemperation valves, upstream isolation valve shall be pneumatic type.~~

4.01.00 General

~~4.01.01 Control valves for regulating service shall normally be globe body, preferably cage guided, metal to metal seated, pneumatically operated and shall be provided with characterized plugs having ANSI leakage class IV except for the control valves indicated above.~~

~~4.01.02 Where the operating time is critical for the operation of the plant, as in case of HP or LP bypass valves, hydraulic actuators with electro hydraulic interface shall be offered.~~

~~4.01.03 Bonnet joints for all control valves shall be of flanged and bolted type.~~

~~4.01.04 Flanged valve shall be rated at no less than class 300 lbs.~~

~~4.01.05 Valve Body / End Connections~~

- ~~4.09.00 ~~Valve Accessories~~~~
~~Accessories shall include side mounted hand wheels, limit switches, junction boxes, airlock relays etc.. Solenoid valve wherever required shall be furnished.~~
- 5.00.00 **CONTROL DESK / PANEL / RACK**
- 5.01.00 Convenient and logical approach to operational interfaces and aesthetics in the overall view of the panel /desk shall be considered.
- 5.02.00 For items susceptible to vibration, suitable anti-vibration padding shall be provided to prevent damage or malfunction.
- 5.03.00 All items inside the panels/cabinets shall be neatly arranged with easy access/maintenance approach.
- 5.04.00 Incoming power supply feeders shall be duplicated. Alarm shall be provided for failure of a power supply feed.
- 5.05.00 Desk / panel shall be provided with interior illumination, utility receptacles with plug and cooling fan.
- 5.06.00 Panel / Desk shall have gland plate at cable entry to panel. Thickness of gland plate shall not be less than 3 mm.
- 5.07.00 Wire shall be routed / laid through covered trough.
- 5.08.00 Crating of the panels and desks shall be suitable for protection against shock, vibration, inappropriate handling and inclement weather conditions during transportation and warehousing. Mounted equipment shall have adequate protection against damage during handling, transit and storage. Suitable desiccant shall be used inside the packing case.
- 5.09.00 Nameplate
- a) Nameplate shall be provided for instrument or device mounted on the panel.
- b) Nameplates for panels shall be provided both in front and rear.
- 5.10.00 Control Desks
- 5.10.01 Devices mounted on the desks shall be flush type. Devices shall be so mounted that their removal and replacement can be accomplished without interruption of services to others.
- 5.10.02 Desk shall be ergonomically designed to suit working on a 24 X 7 basis. Aesthetics, ergonomics and illumination shall be considered while positioning of the desk, large video screen and panels in control room.
- 5.10.03 Control desk shall be free standing floor mounting type of table-top design with compartments for locating the hardware. Desk shall be constructed from aluminum extrusion with high pressure laminate MDF board for work surface of approved colour. Aluminium structure shall be anodized or powder coated paint finish.
- 5.10.04 Monitors with retractable keyboard, emergency push buttons shall be provided on the desk. Desk shall be arranged in arc-like shape without any sharp edges. Edges shall be extruded PVC or rounded post-formed laminate..
- 5.10.05 Desks shall be of modular, scalable and industrially ruggedized design and shall have Telephones and Intercom connections.
- 5.10.06 Desks shall have concealed cable trays for wire dressing.

- 5.10.07 Design shall include Earthing bolts.
- 5.10.08 Back installed items shall be suitably concealed from front view.
- 5.11.00 Back Up Panel
- 5.11.01 Construction shall be from sheet steel of thickness not less than 3mm.
- 5.11.02 Electrical upright Panel construction & design shall be similar to back up panel. Control switches, meters, indicators, synchronizer, excitation control switch, annunciation window etc. along with associated mimic diagram, as recommended, shall be provided for manual synchronization of generator.
- 5.12.00 Cabinets / Enclosure / Panels
01. Material of construction : Cold rolled steel sheet
 02. Thickness of Sheet : a) 3.0 mm for faces supporting instruments / terminals.
b) 2 mm for other sides and top.
 03. Construction : Welded throughout as per approved National Standards.
 04. Panel height : 2300 mm (approx)
 05. i) Corners : 7 mm inner radius
ii) Dimensional Tolerances : a) In height & length - 3 mm
b) In height between adjacent sections - 2 mm.
c) Total for a group - 6 mm
 06. Doors : Double, recessed, turned back edges
 - i) Thickness of Sheet : 2 mm
 - ii) Hinges : Stainless steel
 - iii) Door latches : Three point type
 - iv) Door gaskets : Neoprene rubber on fixed frame to result dust proof/weatherproof enclosure.
 - v) Opening of the doors : Outward
 - vi) Louvers : With removable wire mesh to ensure dust and vermin proof.
 07. Color of interior : Brilliant white
 08. Colour external : RAL 7032
 09. Painting : Epoxy powder coated or better
 10. Gland plates : Removable 4 mm thick (bottom)
 11. Cable entry : Bottom
 12. Hardware : a) Anti vibration pad- 15 mm
b) Predrilled base channel ISMC - 100 or equivalent for all sides.

- c) Stainless steel buff- finished 2 mm thick kick plate for all sides.
- d) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws.
- e) Rubber strips to ensure air tightness between kick plate and finished floor.
- f) Lifting hook / Eye bolt
- g) Drawing pocket
- h) Door switch, lamps, thermostat, heaters and fans

13. Enclosure Protection : As per environment condition of the area of installation. Refer section-I of this vol.

5.13.00 Local Instrument Racks & Enclosure

5.13.01 General Requirements

- a) Devices located in the field shall be grouped and installed in the enclosure (Open / Closed Rack) in Boiler and TG Building.
- b) Racks and enclosure shall be factory prefabricated & painted and shall complete with internal piping, tubing, manifold, isolation valves, blowdown valves, integral junction box, illumination etc.
- c) No more than six instruments shall be grouped in a single rack / enclosure.
- d) Racks shall be installed above the tapping points for air, flue gas and coal air mixture application whereas for applications such as for water and steam, racks to be installed below the source point.
- e) Attention shall be paid in the layout to avoid air traps in liquid piping and water accumulation in air /gas piping.
- f) Welding of impulse lines shall comply with the provisions of the latest applicable ANSI Code for Pressure Piping.
- g) Instrument piping and tubing shall be hydrostatically tested at one and one-half times the maximum system pressure except for low pressure and vacuum measurement for which the test pressure will be as per piping standard.
- h) Service air connection shall be provided for continuous and intermittent purging of impulse pipe in dusty medium. Continuous purging shall be adopted for differential pressure measurement such as flue gas and coal air mixture application. Pressure measurement shall have only intermittent purging whenever required. In case of continuous purging, an air header shall be formed this shall receive service air through isolation valve and air filter regulator. Air shall be fed from the air header to both the impulse pipes near to take off points through isolation valves and flow regulators. Air header shall be constructed from stainless steel. Impulse pipe for such applications shall have a four-way valve. One port of the valve shall have an adaptor to connect flexible stainless steel braided nylon hose to the service air. Rating of the hose shall not be less than 10 Kg/sq.cm.

Four way valve shall have two position operations. One position for service and other one for purging. Required pressure gauges shall be provided for monitoring of air pressure. Complete purging arrangement shall be integral to the enclosure and racks.

- i) Gate or ball type (full ported) instrument isolation valve and globe type blow down drain valve adequate for duty requirement and for withstanding continuous design pressure and temperature of main process medium shall be provided in the hook up plumbing. For process pressure equal or above 40 kg / sq.cm single instrument isolation valve and double blowdown valves shall be used before connecting to blowdown header. Whereas for line pressure less than 40 kg/ sq.cm, single instrument isolation valve and single blow down valves can be used before connecting to blow down header. Instrument manifolds shall be non integral and shall be installed close to the instrument.
- j) Drawing K9213R-DWG-I-0200 shall be referred for typical arrangement of Local instrument enclosure and rack.

5.13.02 Closed Instrument Rack

- a) Enclosure shall be free standing type. Racks shall be adequately reinforced to ensure true surfaces and to provide support. Major load-bearing posts shall be suitably supported by gusset plates or moment members.
- b) Enclosure outer shall be constructed from at least 3 mm thick steel plate and epoxy painted to shade gray. Base frame shall be made of ISMC 100 and black colour finish.
- c) 2" NB galvanized pipes shall be laid horizontally and supported at two end channels to mount transmitters at accessible height. Center posts or any member, which would reduce access, shall be avoided.
- d) Double leaf interlocking front opening doors with three point locking shall be provided and shall be arranged for maximum possible access to the interior. Key shall be of identical for all enclosures.
- e) Doors shall have concealed quick removal type pinned stainless steel hinges and locking handles. Gaskets shall be used between all mating sections to achieve dust and weather proof enclosure rated for IP-65 including the internal junction box.
- f) Removable type bulkhead plates of thickness not less than 6 mm shall be mounted at the racks with suitable high temperature gasket. Impulse lines within the enclosures shall be properly clamped.
- g) All internal wirings between the instruments and junction box shall run through flexible conduits.
- h) Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Header shall be of 2" NB ASTM A 106, Sch-80 Gr. C installed at a slope of 1:25 and extended beyond the rack for connection to plant drain header.
- i) Each rack shall be provided with one receptacle, light fixtures each at instrument & Junction box compartments with wire guard.

5.13.03 Open Instrument Rack

- a) Rack shall be free standing type constructed from 6 mm thick steel channel frame provided with a canopy to protect the instrument from dripping water or falling objects and shall be epoxy painted. Rack Major load-bearing posts shall be suitably supported by gusset plates or moment members. Suitable protective grill shall be welded to the end-posts of the rack to outline a boundary beyond which no mounted equipment shall project. Canopy shall be of CRCA steel sheet of at least 3 mm thickness. Center posts or any member, which would reduce access, shall be avoided.
- b) 2" NB galvanized pipes laid horizontally and supported at two end channels shall be employed at working accessible height for mounting of instruments.
- c) All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings are admissible.
- d) All racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Header shall be of 2" NB ASTM A 106, Sch-80 Gr. C installed at a slope of 1:25 and extended beyond the rack for connection to plant drain header.

5.13.04 Junction Box

Junction boxes of FRP construction with protection class conforming to IP 55.

- a) Junction box shall be provided at a dry compartment at one side of the enclosure / rack with front opening type door. Earth stud shall be furnished at rack for safety grounding.
- b) Terminals shall be screwless cage clamp type of reputed make and 20% spare terminals shall be furnished in the junction box.

~~6.00.00 DISTRIBUTED CONTROL SYSTEM (DCS)~~

~~6.01.00 System Functional Description~~

- ~~6.01.01 Integrated functionally distributed and hierarchically structured real time control (both binary and modulating), Data acquisition, Man machine interface, Historization units and Management Information System (MIS) system synthesized from one general family of identical interchangeable multifunction hardware has been envisaged.~~
- ~~6.01.02 System shall be highly reliable with the availability of not less than 99.7% with adequate redundancy and fault tolerant configuration.~~
- ~~6.01.03 The system shall be unitized and connectivity with other plant control system.~~
- ~~6.01.04 Remote input output stations as a data concentrator for acquisition and monitoring of Boiler metal temperature are foreseen. RIO shall be industrially ruggedized and shall be provided with integral air conditioner considering the harsh environment.~~
- ~~6.01.05 For Power supply to system refer Volume IIE Section I.~~
- ~~6.01.06 Controls of some plant auxiliaries for CW & ACW Pumps and Fuel oil heating & pressurizing system controls shall be realized in DCS through Remote I/O (RIO) cabinets.~~
- ~~6.01.07 Off site & BOP plants such as Coal Handling Plant, Ash Handling Plant, Raw water & Pretreatment plant, Compressed Air System, Mill Reject System and Demineralized water plant etc. having microprocessor based or PLC based~~

~~8.18.01 A Portable data collector shall be provided for taking periodic collection of non critical machine data. Machine condition monitoring system shall be capable to analyze the data. Instrument shall be microprocessor based and ready for use in harsh environment. Integral LCD display shall provide the necessary display of readings & spectral data. Minimum 02 channels along with additional input for phase reference measurement shall be available with the instrument.~~

~~8.18.02 Instrument shall include necessary accelerometers and other devices with accessories for collection of machine parameters. A long life Ni Cd battery pack shall be used. Replacement of battery shall not lead to loss of stored data.~~

~~8.18.03 Shaker table shall be provided for testing & calibration.~~

9.00.00 INSTRUMENTATION & CONTROL CABLE

9.01.00 Cables shall be flame retardant low smoke (FRLS) type. In hazardous areas cables of suitable R/L ratio shall be provided for intrinsic safety.

9.02.00 Durable marking shall be provided on the surface of the cable at intervals not exceeding 5 mtrs. Marking shall include Manufacturer's name, Year of manufacture, Voltage grade, Type of cables (Conductor size & no. of pairs / triads / type of compensating /extension cable), Insulation material, FRLS etc.

9.03.00 Sequential length marking shall also be provided at every meter interval on outer sheath of cable.

9.04.00 Standard seasoned wooden drum containing minimum 500 /1000 M $\pm$ 5% length. Drum shall be anti rodent, anti termite and smooth finish. Both end of cable shall be capped by means of non hygroscopic sealing material.

9.05.00 Thermocouple Extension & Compensating Cable

- | | | |
|-----------------------------|---|--|
| 01. Conductor | : | Solid conductor |
| 02. Conductor size | : | 0.75 sq.mm |
| 03. Type | : | KX (Extension) (Chromel Alumel)
RX (Compensating) (Copper-Copper alloy) JX (Extension) (Iron Constantan) |
| 04. Conductor Insulation | : | HR PVC Type-C (IS-5831,1984) 0.6 mm thick |
| 05. Operating Voltage | : | 300V /500V RMS (Core to earth / core to core) |
| 06. Twisting | : | Pair twisted with lay of 60 mm (max) |
| 07. Twisting Direction | : | All pairs in the same direction. Lapped to form bunch with mylar tape. |
| 08. Screen (Pair & Overall) | : | Aluminium mylar tape with a thickness of 28 μ m (min.) for individual pair screen and 60 μ m (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyester tape shall be applied with minimum overlap of 25%. Metallic side of the screen shall be in contact with drain wire. |

- | | | | |
|-----|---------------------------------|---|--|
| 09. | Drain wire | : | Annealed tinned copper wire, stranded.
Size 0.5 Sq. mm. (No. of strands / size:-
7 / 0.3mm) |
| 10. | Inner Sheath | : | Extruded FRLS PVC (anti rodent, anti
termite & moisture resistant properties)
HR PVC Type ST2 of IS-5831,1984
Thickness as per IS-1554Part-I 1976 |
| 11. | Rip Cord | : | Non metallic under sheath |
| 12. | Armouring | : | GI wire / strip as per IS 3975 |
| 13. | Outer Sheath | : | Extruded FRLS PVC (anti rodent, anti
termite & moisture resistant properties)
HR PVC Type ST2 of IS-5831,1984
Thickness as per IS-1554Part-I 1976 |
| 14. | Filler | : | Non hygroscopic with FRLS property |
| 15. | Temperature Range | : | Up to 85 °C |
| 16. | Insulation at 20 ⁰ C | : | 100 MOhms/Km [Min] |
| 17. | Capacitance at 800 Hz | : | 120 nf/km |
| 18. | Cross talk | : | 60 dB |
| 19. | Attenuation | : | 1.2 dB/Km |
| 20. | Codes & Standards | : | a) IEC 332-1
b) ANSI MC 96.1
c) IS-8784-1987 |
| 21. | Tests | : | a) Oxygen Index: Min.29 at room
temp. (ASTM-D-2863)
b) Acid Gas Gen.: Max.20% by weight
as per IEC 754 Part-I
c) Temp Index : Min 250 DEG C at
21Oxy. Ind. (ASTM-D-2863)
d) Smoke Density Rating : Max.60%
(ASTM-D-2843).
e) Flammability Test : as per IEC 332
Part-I /IEEE-383
Swedish Chimney Test - SS-424-
1475 F3
f) High voltage test
Core to core- 1.5 KV for 1 min.
Core to screen- 1.0 KV for 1 min.
g) Insulation Resistance 100 M Ohm /
Km Min |

- h) Rodent & Termite repulsion test
(Presence of lead shall be confirmed)

22. Conductor material & sheath color for thermocouple cable as per ANSI MC 96.1

CABLE TYPE	OVERALL SHEATH COLOR	WIRE	SHEATH COLOR	CONDUCTOR MATERIAL
KX	Yellow	Positive	Yellow	Nickel / Chromium
		Negative	Red	Nickel / Aluminum
JX	Black	Positive	White	Iron
		Negative	Red	Constantan
RX	Green	Positive	Black	Copper
		Negative	Red	Copper Nickel Alloy

23. Durable printed or embossed numbering at regular interval of 50mm shall be provided for identification of pairs.

9.06.00 Instrumentation multi Paired Signal Cable

01. Conductor type : Stranded (7) annealed tinned copper
02. Conductor size : 0.5 / 1.0 / 1.5 Sq.mm (as required)
03. Conductor resistance : 39 Ω/Km/18 Ω/Km/12 Ω/Km
04. Conductor Insulation : HR PVC Type-C (IS-5831,1984) 0.6 mm thick
05. Operating Voltage : 300 / 500V RMS (Core to earth / core to core)
06. Twisting : Twin twisted with lay of 60 mm
07. Twisting Direction : All pairs in the same direction. Lapped to form bunch with mylar tape.
08. Screen (Pair & Overall) : Aluminium mylar tape with a thickness of 28 μm (min.) for individual pair screen and 60 μm (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyester tape shall be applied with minimum overlap of 25%. Metallic side of the screen shall be in contact with drain wire.
 - * Analog signals- Individual pair & overall shield to be considered.
 - * Binary signals- overall shield to be considered.

- | | | | |
|-----|------------------------|---|---|
| 09. | Drain wire | : | Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands / size:- 7 / 0.3mm) |
| 10. | Inner Sheath | : | Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties)
HR PVC Type ST2 of IS-5831,1984
Thickness as per IS-1554, Part-I 1976 |
| 11. | Rip Cord | : | Non metallic under sheath |
| 12. | Armouring | : | GI wire / strip as per IS 3975 |
| 13. | Outer Sheath | : | Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties)
HR PVC Type ST2 of IS-5831,1984
Thickness as per IS-1554, Part-I 1976 |
| 14. | Filler | : | Non hygroscopic with FRLS property. |
| 15. | Temperature Range | : | 85 °C |
| 16. | Insulation at 20 Deg.C | : | 100 MOhms/Km [Min] |
| 17. | Capacitance at 800 Hz | : | 120 nf/km |
| 18. | Cross talk | : | 60 dB |
| 19. | Attenuation | : | 1.2 dB/Km |
| 20. | Codes & Standards | : | a) IPCEA-S-61-402
b) BS 5308
c) IEC 332-1
d) ASTM-B-33
e) IS-8130-1984
f) IS 1554 Part-1
g) IS 10810 |
| 21. | Sheath colour | : | Inner- Black and Outer- Gray |
| 22. | Tests | : | a) Oxygen Index: Min.29 at room temp. (ASTM-D-2863)
b) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I
c) Temp Index : Min 250 ° C at 21Oxy. Ind. (ASTM-D-2863)
d) Smoke Density Rating : Max.60% (ASTM-D-2843).
e) Flammability Test : as per IEC 332 Part-I
f) Swedish Chimney Test-SS-424-1475 F3
g) Insulation Resistance 100 M Ohm / Km Min |