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.

Gujarat State Electricity Corpn. Ltd. GSECL P&P Vadodara
Bharat Heavy Electricals Limited PS-Mktg. Delhi

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 on 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.

GSECL P&P Vadodara
Bharat Heavy Electricals Limited PS-Mktg. Delhi

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 alter 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

Bharat Heavy Electricals Limited PS-Mktg. Delhi

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.

Gujarat State Electricity Corp. Ltd. GSECL P&P Vadodara
Bharat Heavy Electricals Limited PS-Mktg. Delhi

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.

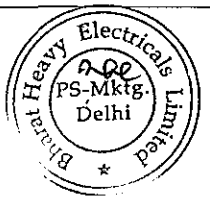
37.4 The perils required to be covered under the insurance shall include, but not limited to fire and allied risks, miscellaneous accidents (erection risks), workmen compensation risks, loss or damage in transit, theft, pilferage, riot and strike and malicious damages, civil commotion, weather conditions, 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 bearings, 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

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

Bharat Heavy Electricals Limited PS-Mktg. Delhi
Electricity Corpn. Ltd GSECL P&P Vadodara

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)) Cl 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 it's Associates. As such, Contractor confirms and agrees that no other customer of the Contractor or it's 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.

Bharat Heavy Electricals Limited PS-Mktg. Delhi
Gujarat State Electricity Corpn. Ltd. GSECL PSP Vadodara

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.

Gujarat State Electricity Corpn. Ltd. GSECL P&P Vadodara
Bharat Heavy Electricals Limited PS-Mktg. Delhi

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

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.

080

Bharat Heavy Electricals Limited PS-Mktg. Delhi

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.

Gujarat State Electricity Corpn. Ltd. GSECL P&P Vadodara

081

Bharat Heavy Electricals Limited PS- Mktg. Delhi

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.

082

Bharat Heavy Electricals Ltd. PS-Mktg. Delhi

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 the 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.

Gujarat State Electricity Corpn. Ltd. Vadodara P&P
086
Bharat Heavy Electricals Limited PS-Mktg. Delhi

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) Attemperation 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.

087

Gujarat State Electricity Corpn. Ltd. GSECL P&P Vadodara
Bharat Heavy Electricals Limited PS- Mktg. Delhi

2.08.03 Supply of all consumables, e.g. welding electrodes, cleaning agents, diesel oil, grease, lubricant etc. as well as materials required for temporary supports, scaffolding etc. as necessary for such erection work except those listed under exclusion elsewhere in this specification.

2.08.04 Construction of all civil/structural/architectural works, including construction of foundation for all equipment supplied as required, grouting of equipment on foundation after alignment, and all other incidental civil activities as detailed elsewhere.

2.08.05 All structural steel fabrication and erection work as detailed elsewhere in the specification.

2.08.06 Providing support services for the Contractor's erection staff e.g. construction of site offices, temporary stores, residential accommodation and transport to work site for erection personnel, insurance cover, watch & ward for security and safety of the materials under the Contractor's custody etc. as required.

2.08.07 Maintaining proper documentation of all the site activities undertaken by the Contractor as per the proforma mutually agreed with the Owner; submitting monthly progress reports as also any such document as and when desired by the Owner; taking approval of all statutory authorities e.g. Boiler Inspector, Factory Inspector, Inspector of Explosives etc. for respective portions of work under the jurisdiction of such statutes or laws.

2.08.08 The Contractor shall provide `Industrial Relations' unit and `Medical' unit to take care of his erection staff and the Owner shall have no obligation in the regard.

2.08.09 The successful Bidder shall arrange for Tower crane of adequate capacity for speedy erection activities.

2.09.00 **Site Organisation**

The Contractor shall maintain a site organisation of adequate strength in respect of manpower, construction machinery and other implements at all times for smooth execution of the contract. This organisation shall be reinforced from time to time, as required, to make up for slippages from the schedule without any commercial implication to the Owner. The site organisation shall be headed by a competent construction manager having sufficient authority to take decisions at site.

On award of contract, the Contractor shall submit to the Owner a site organisation chart indicating the various levels of experts to be deployed on the job. The Owner reserves the right to reject or approve the list of personnel proposed by the Contractor. The persons, whose bio-data have been approved by the Owner, will have to be posted at site and deviations in this regard will not generally be permitted.

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.

088

Bharat Heavy Electricals Limited PS-Mktg. Delhi

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.

Bharat Heavy Electricals Limited PS- Mktg. Delhi

090

Page 181 of 529

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.

092

Bharat Heavy Electricals Limited PS-Mktg. Delhi

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.

094

Bharat Heavy Electricals Limited PS-Mktg. Delhi

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.

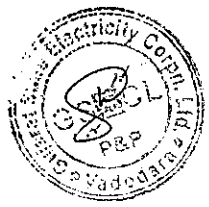
2.13.18 All welded joints shall be painted with anti-corrosive paint immediately on completion of radiography and stress-relieving.

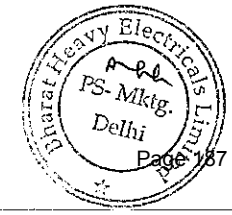
2.14.00 For further details on procedures of work at site on civil, architectural, electrical and instrumentation & control services, refer Volume : II-E, II-F & II-G of this specification.

VOLUME : IIA

SECTION-VI

ENGINEERING SERVICES





CONTENT

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.

Bharat Heavy Electricals Limited PS- Mktg. Delhi

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.

Gujarat State Electricity Corpn. Ltd. GSECL P&P Vadodara

Bharat Heavy Electricals Limited PS- Mktg. Delhi

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.

GSECL P&P Gujarat State Electricity Corporation Ltd. Vadodara

Bharat Heavy Electricals Limited PS-Mktg. Delhi

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.

105

VOLUME : IIA

SECTION-VII

QUALITY ASSURANCE REQUIREMENTS

CONTENT

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.

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-IA (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. : _____ Contractor : _____			QP No. : _____ Date _____ 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

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

114

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

Bharat Heavy Electricals Limited PS- Mktg. Delhi

Gujarat State Electricity Corpn. Ltd. Engineering

VOLUME : IIA

SECTION - X

PERFORMANCE GUARANTEES AND TESTS

(ONLY RELEVANCE PORTION RELATED TO CHLORINATION PLANT OF THIS SECTION TO BE REFERED)

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.

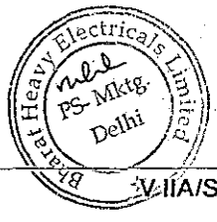
1.06.04 For Total Auxiliary Power Consumption, the transformers listed under the respective clauses, shall be taken together for purposes of guarantee and not individually.

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

Gujarat State Electricity Corporation Ltd. Vadodara
Bharat Heavy Electricals Limited PS- Mktg. Delhi

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 with holding 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.

Bharat Heavy Electricals Limited
PS- Mktg.
Delhi

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 ± 3 kg/cm^2, 566 ± 3^{0}C, 593^{0}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^{0}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 :

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

   a) 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-IIC-Sec.01.

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

2. 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.

3. For intermittent running auxiliaries i.e., AC & Ventilation system, and outdoor area illumination, a duty factor of 0.5 shall be considered.

4. 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.

5. 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/Nm^3 (equivalent NO_2) 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.

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 Attemperation System

The Bidder shall guarantee and demonstrate that the spray water flow to SH attemperation 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 attemperation 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 alongwith 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 VWO 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 VWO 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

Bharat Heavy Electricals Limited
PS- Mktg.
Delhi

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.

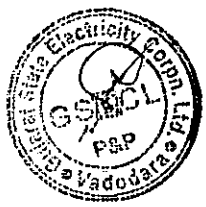
5.06.00 **Remaining Plant and Equipment**

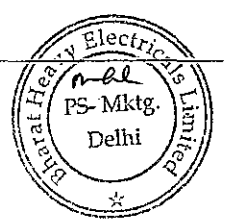
For other equipment, plants and systems, the performance test shall be carried out as per the respective equipment specification and the applicable codes.

VOLUME : IIA

SECTION-VIII

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





CONTENT

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.

Bharat Heavy Electricals Limited
PS- Mktg.
Delhi

SECTION: C-3
TECHNICAL SPECIFICATION (ELECTRICAL PORTION)

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 CHLORINATION 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) Purchaser will furnish data sheets to the vendor after award of contract. Vendor shall furnish filled in data sheets meeting the specification requirements.

k) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.

l) 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) A copy of this sheet "Electrical Equipment Specification for Chlorination Plant" and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.
b) Electrical load requirement.

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.

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)~~

PROJECT: 1 x 800 MW WANAKBORI TPS

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE: CHLORINATION PLANT

REV: 0 DATE: 26.08.2015

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	1. 415 V AC (3 Phase, 3 Wire) supply to motors, 415 V AC (3 Phase, 4 Wire) /240 V AC supply to other equipment etc. shall be provided by BHEL based on load data provided by vendor at contract stage for the equipment supplied by vendor as part of contract. 2. 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	Refer C & I portion of specification for philosophy of using junction boxes
5	Any special type of cable like compensating, co-axial, prefab, MICC, fibre optical etc.	Vendor	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
6	a) Cable trays, accessories & cable trays supporting system b) 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, which shall be supplied by vendor.
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 Aluminium lugs for Aluminium power cables and heavy duty tinned copper lugs for copper power cables 3. Solder less crimping type heavy duty copper lugs for control cables.
8	Conduit and conduit accessories for cabling between equipments 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 & lightning protection	BHEL	BHEL	
11	Below grade grounding	BHEL	BHEL	
12	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage. All motors shall be 3 Phase only.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares	Vendor	-	Not applicable for this project.

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE: CHLORINATION PLANT

REV: 0 DATE: 26.08.2015

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
15	Any other equipment/material/service required for completeness of system but not specified above (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 (excluding power cables) 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 equipments/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.

LOAD TITLE	RATING (KW / A)		FULL LOAD CURRENT FLC(A)	UNIT (U)/STN. (S)	Nos.		VOLTAGE CODE*	FEEDER CODE*	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME> 5 SEC (Y)	LOCATION (Tag. No.)	RATING & FLC CHECKED FROM MOTOR/VALVE APPROVED DATASHEET (Y/N)	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.	KKS NO.
	NAME PALTE	MAX. CONT. DEMAND (MCR)			RUNNING	STANDBY									SIZE CODE	Nos					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
NOTES: 1. COLUMN 1 TO 14 & 20 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)																					
2. ABBREVIATTIONS : * VOLTAGE CODE (7):- (AC) A=11 KV, B=6.6.KV, C= 3.3 KV, D=415 V, E = 240 V (1 PH), F = 110 V (DC) : G =220V, H = 110 V, J = 48 V, K = +24V, L= -24V																					
: **FEEDER CODE (8) :- U = UNIDIRECTIONAL STARTER, B = BIDIRECTIONAL STARTER, S = SUPPLY FEEDER, D = SUPPLY FEEDER (CONTACTOR CONTROLLED)																					
BHEL	LOAD DATA (ELECTRICAL)		JOB NO.										ORIGINATING AGENCY				PEM (ELECTRICAL)				
			PROJECT TITLE										NAME				DATA FILLED UP ON				
			SYSTEM / S										SIGN.				DATA ENTERED ON				
			DEPTT. /SECTION										SHEET 1/2		REV. R0		DE'S SIGN. & DATE				

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

1. SCOPE OF SUPPLY

Instrumentation (Minimum) as shown in the P&ID, 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.

One number PLC based control panel for the control of complete Chlorination plant (CW and RW).

2.0 CONTROL PHILOSOPHY (CW & RW CHLORINATION SYSTEM)

2.1 CW CHLORINATION SYSTEM

2.1.1 OPERATION, CONTROL PHILOSOPHY & INSTRUMENTATION

The operation of the chlorinator shall be manually operated from programmable logic controller (located at CW Chlorination building). Starting & stopping of the plant shall be done manually. To maintain residual chlorine of 0.2 to 0.5 ppm, on line residual chlorine analyser provided at the suction of booster pump measures the residual chlorine and chlorine feed rate shall be manually adjusted by operator, based on on-line reading of residual chlorine analyzer. The operation of CW chlorination system shall be PLC based with one (1) no. Operator Work Station (OWS) & one (1) no. Operator cum Engineering Work Station (OEWS).Also One (1) A3 size colour laser jet printer is envisaged for printing of various logs, reports, graphics etc. CW Chlorination plant PLC shall be connected to Main plant DCS through soft link for monitoring.

Local start and stop shall be provided for all drive motors. Local start shall be possible through remote/local selection key in Operating Station or in MCC. Tripping of drive motors locally shall be permissible irrespective of position of remote/local selector switch. Provision for locking the local stop push buttons after tripping the motor from local push button shall be there.

ON/OFF/TRIP status of all pumps, blowers, agitators and drive motors, as required shall be displayed on OWS. Further, Current indication wherever applicable shall be displayed on OWS.

Since the dosing rate of chlorine is low in the continuous operation, only one stream shall be under operation and the three streams shall be kept as stand-by. However in shock dosing mode, three number streams shall be kept under operation and one number of stream shall be kept under stand-by. Accordingly only one booster pump shall be put in service in continuous dosing operation and the other three pumps shall be kept as stand-by while in shock dosing mode three number pumps shall be kept under service and one number pump shall be kept as stand-by.

In operation work station following controls has been envisaged:-

a) EVAPORATOR WATER LEVEL CONTROLS

The water level control switch controls the normal level of water by opening / closing the solenoid valve on evaporator make-up water line. The low water level switch gives the alarm annunciation on low level of water shuts off the heater power supply on the further reduction in water level. Water level control switch (LSC) operates to maintain the water bath level automatically within preset limits by incorporating level controller and make up valve.

b) EVAPORATOR WATER BATH TEMPERETURE CONTROL

The following provisions are made for water bath Temperature control:

Low temperature alarm switch	:	77 deg. C
High temperature alarm switch	:	88 deg. C

Control thermostat : 82 deg. C

Evaporator immersion heater will energise, if the following conditions are satisfied:

- Water level normal (above low level)
- Water bath Temperature below 80 deg. C. (Set in heater control Temperature switch).

Immersion heater power supply will be cut off as soon as water bath Temperature reaches 85 deg.+ - 5 deg. C. It will be re-energised, when water bath Temperature goes below 80 deg. C. In case heater control Temperature switch fails to cut-off power supply to heater, water bath temperature will increase & water bath Temperature may reach boiling point. To avoid this, a 'high-high' Temperature switch with alarm set at 90 deg.C shall be provided to cut off heater power supply when water bath Temperature goes above 90 deg.C ('High Temperature of Evaporator Water Bath'). This condition shall be indicated in alarm annunciation system also.

c) CHLORINE GAS AUTOMATIC SHUT OFF VALVE CONTROL (ASV VALVE)

To avoid damage to the chlorinator due to flooding of liquid chlorine, an motorised auto shut-off valve shall close if either of the following conditions persists:

- low gas temperature in the evaporator,
- Low water pressure at inlet to ejector.
- Break of vacuum in the chlorinator.

The auto shut off valve on chlorine gas line shall open automatically if all the following conditions are satisfied:

i) Evaporator water bath : above 77deg.C.
ii) Injector water pressure : Set point to be decided during detailed engineering.
iii) Vacuum at chlorinator : above 100 mm of Hg.

In case any of the above conditions fails, the ASV valve will close automatically. Thus suitable interlocking has been provided to operate the ASV motor. Evaporator water bath Temperature low, Injector water pressure low & loss of vacuum in the chlorinator shall be indicated in alarm enunciator system. In case of non-functioning of low-pressure switch at booster pump discharge, ASV will stop even for tripping of booster pumps trip.

d) EVAPORATOR CATHODIC PROTECTION CONTROLS

To avoid rusting of hot water tank inside & external of chamber of Evaporator, cathodic protection has been envisaged.

e) INJECTOR WATER BOOSTER PUMP

Four (4) nos. pumps [(3W+1S]-Shock Dosing & [1W+3S]-Cont. Dosing] have been provided for chlorinator operation. Pump shall not start during suction pressure low condition. One number pressure switch is provided on common suction line. For this purpose the pressure switch shall be set at the required pressure.

The following provisions are made on PLC based OWS:

I. Pump start/stop facility.
II. Pump on/off indication.
III. Pump trip indication.
IV. Exhaust fan start/stop, trip, selector switch, indications.
V. Agitator start/stop, trip, selector switch, indications.

VI. Caustic pump start/stop, trip, selector switch, indications.

The following annunciation points has been provided,

I. Pump suction pressure low.
II. Pump over load trip.

In addition a start/stop facility for all atmospheric ventilation fans shall be provided.

During normal operation of plant the exhaust fans provided in the chlorinator room shall be running. However, any chlorine gas leakage in chlorinator and / or storage room, as sensed by the chlorine leak detector, shall give an alarm & exhaust fans shall stop automatically. Simultaneously the absorption system and blowers shall come into operation.

2.1.2 CHLORINE ABSORPTION SYSTEM CONTROL

Chlorine absorption can be operated automatically. Auto operation is achieved through chlorine leak detector. However, manual operation of the plant has also been envisaged. For this purpose an AUTO/MANUAL selector switch shall be provided.

In the event of leakage from ton container, the chlorine detector (provided at different area of plant) will give audio-visual annunciation when the concentration of chlorine exceeds above 1 PPM and it will start caustic recirculation pump and blower. When the concentration falls below safe level (i.e. below 0.1 ppm), an audio/visual annunciation to the effect will be given and then operation will manually switch off the absorption system.

Manual Operation

During manual operation, operator has to start the caustic recirculation pump and blower from Operator Work Station, during the manual operation also, chlorine leak detector will give audio/visual annunciation when concentration of chlorine exceed above 1 PPM.

For chlorine absorption system controls, the following provisions are made in OWS.

i. Auto/manual selection.
ii. Start/Stop push buttons for circulation pump and blowers.
iii. On/off indications for circulating pump and blowers.
iv. Following annunciations are provided for chlorine absorption system
   - Chlorine leak
   - Caustic circulation pump over load trip.
   - Blower overload trip.
   - Chlorine leak safe level.
v. For caustic storage tank level control two number float type level switch for low level and low-low level are provided at caustic storage tank. During low-level condition alarm shall be annunciated in Operator Work Station. During low-low level the caustic recirculation pumps should not be operated. Hence suitable interlock shall be provided.

vi. One no. hooter will be provided outside the building for chlorine leak indication.

Note- Alarm list of above system shall be provided during detail engineering.

2.2 RW CHLORINATION SYSTEM

2.2.1 OPERATION, CONTROL PHILOSOPHY & INSTRUMENTATION

The operation of the chlorinator shall be manually operated from programmable logic controller (located in PLC Room of Pre-Treatment Plant at Chemical house). Starting & stopping of the plant shall be done manually. Chlorine feed rate shall be manually adjusted by operator, based on residual chlorine. The operation of RW chlorination system shall be PLC based with one (1) no. Operator Work Station & one (1) no. Operator cum Engineering Work Station. Also One (1) A3 size colour laser jet printer is envisaged for printing of various logs, reports, graphics etc. RW Chlorination plant PLC shall be connected to Main plant DCS through soft link for monitoring.

Local start and stop shall be provided for all drive motors. Local start shall be possible through remote/local selection key in OWS or in MCC. Tripping of drive motors locally shall be permissible irrespective of position of remote/local selector switch. Provision for locking the local stop push buttons after tripping the motor from local push button shall be there.

ON/OFF/TRIP status of all pumps, blowers, agitators and drive motors, as required shall be displayed in OWS. Further, Current indication wherever applicable shall be displayed on OWS.

Since the dosing rate of chlorine is low in the continuous operation, only one stream shall be under operation and the three streams shall be kept as stand-by. Accordingly only one booster pump shall be put in service in continuous dosing operation and the other pump shall be kept as stand-by.

In operation work station following controls has been envisaged:-

a) CHLORINE GAS AUTOMATIC SHUT OFF VALVE CONTROL (ASV VALVE)

To avoid damage to the chlorinator due to flooding of liquid chlorine, an motorised auto shut-off valve shall close if either of the following conditions persists:

- Low water pressure at inlet to ejector.
- Break of vacuum in the chlorinator.

The auto shut off valve on chlorine gas line shall open automatically if all the following conditions are satisfied:

i) Injector water pressure : Set point to be decided during detailed engineering.
iii) Vacuum at chlorinator : above 100 mm of Hg.

In case any of the above conditions fails, the ASV valve will close automatically. Thus suitable interlocking has been provided to operate the ASV motor. Evaporator water bath Temperature low, Injector water pressure low & loss of vacuum in the chlorinator shall be indicated in alarm enunciator system. In case of non-functioning of low-pressure switch at booster pump discharge, ASV will stop even for tripping of booster pumps trip.

b) INJECTOR WATER BOOSTER PUMP

Two (2) nos. pumps, have been provided for chlorinator operation. Pump shall not start during suction pressure low condition. One number pressure switch is provided on common suction line. For this purpose the pressure switch shall be set at the required pressure.

The following provisions are made on PLC based OWS:

I. Pump start/stop facility.

II. Pump on/off indication.
III. Pump trip indication.
IV. Exhaust fan start/stop, trip, selector switch, indications.
V. Agitator start/stop, trip, selector switch, indications.
VI. Caustic pump start/stop, trip, selector switch, indications.

The following annunciation points has been provided,

i. Pump suction pressure low.
ii. Pump over load trip.

In addition a start/stop facility for all atmospheric ventilation fans shall be provided.

During normal operation of plant the exhaust fans provided in the chlorinator room shall be running. However, any chlorine gas leakage in chlorinator and / or storage room, as sensed by the chlorine leak detector, shall give an alarm & exhaust fans shall stop automatically. Simultaneously the absorption system and blowers shall come into operation.

2.2.2 CHLORINE ABSORPTION SYSTEM CONTROL

Chlorine absorption can be operated automatically. Auto operation is achieved through chlorine leak detector. However, manual operation of the plant has also been envisaged. For this purpose an AUTO/MANUAL selector switch shall be provided.
In the event of leakage from ton container, the chlorine detector will give audio-visual annunciation when the concentration of chlorine exceeds above 1 PPM and it will start caustic recirculation pump and blower. When the concentration falls below safe level (i.e. below 0.1 ppm), an audio/visual annunciation to the effect will be given and then operation will manually switch off the absorption system.

Manual Operation

During manual operation, operator has to start the caustic recirculation pump and blower from Operator Work Station, during the manual operation also, chlorine leak detector will give audio/visual annunciation when concentration of chlorine exceed above 1 PPM.

For chlorine absorption system controls, the following provisions are made in OWS.

i. Auto/manual selection.
ii. Start/Stop push buttons for circulation pump and blowers.
iii. On/off indications for circulating pump and blowers.
iv. Following annunciations are provided for chlorine absorption system
- Chlorine leak
- Caustic circulation pump over load trip.
- Blower overload trip.
- Chlorine leak safe level.

v. For caustic storage tank level control two number float type level switch for low level and low-low level are provided at caustic storage tank. During low-level condition alarm shall be annunciated in Operator Work Station. During low-low level the caustic recirculation pumps should not be operated. Hence suitable interlock shall be provided.
vi. One no. hooter will be provided outside the building for chlorine leak indication.

Note- Alarm list of above system shall be provided during detail engineering.

Specific Technical Requirements for RW CHLORINATION (C&I):

1) The control of RW Chlorination Plant shall be through PLC based control system having hot redundant Central Processing Unit. The operation and control philosophy of RW Chlorination Plant has been elaborated in separate section in the specification. The PLC shall be located in PT Plant Control Room. One (1) nos. OWS(Operator Works Station) and one(1) no. OEWS(Operator cum Engineering Work Station) with 24" colour TFT monitor ,one(01) nos.A3 size colour laser printers, keyboard, mouse etc. shall be provided by the bidder. OWS/EWS shall be provided with anti-glare coating. In addition to OWS operation, hardware based monitoring / control / annunciation shall be provided for the systems where HMI workstations are not envisaged or need for such back up is strongly recommended by Bidder for the safe shutdown of the system.The Complete PLC based control system with OWS, Laptop, Printer, UPS (for PLC, OWS,Printer etc.), desk along with furniture shall be in Bidder's scope. PC for OWS shall be of workstation grade. Additional laptop loaded with engineering software shall be provided.

2) The communication between PLC and Main plant DCS shall be OPC compliant (Data Access 2.0) TCP/IP on Fibre Optic link. The communication link between PLC and Main plant DCS shall be redundant. The necessary hardware/software including LIU (Light Interface unit) at PLC end shall be in Bidder's scope. Repeaters, if required for interfacing shall also be provided by the bidder. For communication between main plant DCS and PLC, the PLC end shall be considered as server and DCS shall be considered as client.

3) PLC control system shall be time synchronized with the Master clock system of the main plant to ensure uniform time indication throughout the Plant. The required provision (IRIG-B) shall be made by the bidder at the PLC end to achieve the same.

4) The software and hardware for offered PLC system shall be of latest version and shall be upgradable. Bidder to ensure the availability of spares and service support for the offered PLC system for minimum 20 years after guarantee period. The software tool shall have facility to interface with third party software packages. Easy up gradation and future expansion facility shall be available. All softwares used shall be licensed versions only. All software user licenses shall be valid for entire life of power plant and shall be in the name of customer. User shall not have to pay any recurring license fee during the usage period of the system.

It shall be possible to upgrade the installed system with the latest available version of the software model during the plant life.

5) All electrical actuators shall be non-integral type.

6) 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.

7) The solenoid valves shall have limit switches for open/close feedback.

8) Interface of MCC, HT SWGR, Actuators etc. with PLC based control system shall be as per Drive Control Philosophy attached in the specification. The attached philosophy is for DCS based control system. However, the same is applicable for PLC as well.

9) 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.

10) 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.

11) UPS for PLC, OWS etc. shall be in bidder’s scope with 2X100% configuration along with SVS (Static Voltage Stabilizer). UPS shall have 2X100%, VRLA type battery bank with 60 min back up. For further details UPS specification attached elsewhere shall be referred. Redundant UPS power supply shall be extended to PLC etc.

12) Bidder shall provide Customer training on the proper application and maintenance of PLC Hardware & Software at Vendor’s work or at Wanakbori site.

13) Following documents to be furnished by the bidder along with the bid:

- Proposed PLC system configuration drawing with write-up
- Duly stamped and signed copy of Quality Plan.
- Product catalogues and specifications for PLC as well as HMI application.
- Requirement of electronic earthing, if any, for PLC based control system

14) Ergonomically & aesthetically designed furniture viz. control desks & Chairs shall be provided for workstations, programming stations, PCs and various peripherals at control room/computer room/equipment room. Furniture shall include documentation racks, tables for laydown etc. Control Desk profile shall be in line with drawing K9213R-DWG-I-0161.

15) Bidder to comply with codes and standards as mentioned in the specification.

16) All local gauges,transmitters and switches shall be mounted on suitable enclosures, racks subject to owner's approval. All transmitters shall be HART compatible.

17) Bidder to delegate /depute their persons/experts as per owner/consultants' requirement.

18) Bidder must offer general tools and tackles and special calibration instruments required during start-up, trial run, operation and maintenance of the system.

19) 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.

Specific Technical Requirements for CW CHLORINATION (C&I):

1) The control of CW Chlorination Plant shall be through PLC based control system having hot redundant Central Processing Unit. The operation and control philosophy of CW Chlorination Plant has been elaborated in separate section in the specification. The PLC shall be located in CW Chlorination Control Room. One (1) nos. OWS(Operator Works Station) and one(1) no. OEWS(Operator cum Engineering Work Station) with 24" colour TFT monitor ,one(01) nos.A3 size colour laser printers, keyboard, mouse etc. shall be provided by the bidder. OWS/EWS shall be provided with anti-glare coating. In addition to OWS operation, hardware based monitoring / control / annunciation shall be provided for the systems where HMI workstations are not envisaged or need for such back up is strongly recommended by Bidder for the safe shutdown of the system.The Complete PLC based control system with OWS, Laptop, Printer, UPS (for PLC, OWS,Printer etc.), desk along with furniture shall be in Bidder's scope. PC for OWS shall be of workstation grade. Additional laptop loaded with engineering software shall be provided.

2) The communication between PLC and Main plant DCS shall be OPC compliant (Data Access 2.0) TCP/IP on Fibre Optic link. The communication link between PLC and Main plant DCS shall be redundant. The necessary hardware/software including LIU (Light Interface unit) at PLC end shall be in Bidder's scope. Repeaters, if required for interfacing shall also be provided by the bidder. For communication between main plant DCS and PLC, the PLC end shall be considered as server and DCS shall be considered as client.

3) PLC control system shall be time synchronized with the Master clock system of the main plant to ensure uniform time indication throughout the Plant. The required provision (IRIG-B) shall be made by the bidder at the PLC end to achieve the same.

4) The software and hardware for offered PLC system shall be of latest version and shall be upgradable. Bidder to ensure the availability of spares and service support for the offered PLC system for minimum 20 years after guarantee period. The software tool shall have facility to interface with third party software packages. Easy up gradation and future expansion facility shall be available. All softwares used shall be licensed versions only. All software user licenses shall be valid for entire life of power plant and shall be in the name of customer. User shall not have to pay any recurring license fee during the usage period of the system.

It shall be possible to upgrade the installed system with the latest available version of the software model during the plant life.

5) All electrical actuators shall be non-integral type.

6) 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.

7) The solenoid valves shall have limit switches for open/close feedback.

8) Interface of MCC, HT SWGR, Actuators etc. with PLC based control system shall be as per Drive Control Philosophy attached in the specification. The attached philosophy is for DCS based control system. However, the same is applicable for PLC as well.

9) 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.

10) 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.

11) UPS for PLC, OWS etc. shall be in bidder's scope with 2X100% configuration along with SVS (Static Voltage Stabiliser). UPS shall have 2X100%, VRLA type battery bank with 60 min back up. For further details UPS specification attached elsewhere shall be referred. Redundant UPS power supply shall be extended to PLC etc.

12) Bidder shall provide Customer training on the proper application and maintenance of PLC Hardware & Software at Vendor's work or at Wanakbori site.

13) Following documents to be furnished by the bidder along with the bid:

- Proposed PLC system configuration drawing with write-up
- Duly stamped and signed copy of Quality Plan.
- Product catalogues and specifications for PLC as well as HMI application.
- Requirement of electronic earthing, if any, for PLC based control system

14) Ergonomically & aesthetically designed furniture viz. control desks &

Chairs shall be provided for workstations, programming stations, PCs and various peripherals at control room/computer room/equipment room. Furniture shall include documentation racks, tables for laydown etc. Control Desk profile shall be in line with drawing K9213R-DWG-I-0161.

15) Bidder to comply with codes and standards as mentioned in the specification.

16) All local gauges,transmitters and switches shall be mounted on suitable enclosures, racks subject to owner's approval. All transmitters shall be HART compatible.

17) Bidder to delegate /depute their persons/experts as per owner/consultants' requirement.

18) Bidder must offer general tools and tackles and special calibration instruments required during start-up, trial run, operation and maintenance of the system.

19) 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.

SECTION: D
STANDARD TECHNICAL SPECIFICATIONS

SECTION-D1

(GENERAL TECHNICAL REQUIREMENT FOR MECHANICAL)

1. INTRODUCTION (CW & RW CHLORINATION SYSTEM)

This section covers the basis of design, system philosophy, equipment selection and layout aspects of CW & RW Chlorination System.

2. SYSTEM DESCRIPTION (CW & RW CHLORINATION SYSTEM)

2.1 DESIGN PHILOSOPHY FOR CW CHLORINATION

CW Chlorination Plant has been designed to dose required quantity of chlorine to Cooling Water system. Chlorine gas shall be mixed thoroughly with the water in the ejector provided in the system. The chlorine solution thus obtained shall be dosed in CW pump inlet in CW sump. System has been designed for shock dosing of chlorine at the rate of 5 ppm for 0.5 hr in a shift and continuous dosing at the rate of 1.0 ppm for 7.5 hrs per shift, to control the microbiological growth. However, the actual dosing level shall be set by the operator based on residual chlorine measurement at the CW sump.To maintain residual chlorine of 0.2 to 0.5 ppm, on line residual chlorine analyzer provided at the suction booster pumps, measures the residual chlorine.Chlorine feed rate shall be manually adjusted by operator, based on on-line reading of residual chlorine analyzer. The measurement of residual chlorine shall be indicated in the PLC based Operator Work Station. However a provision shall be given to control the chlorination dosing rate through PLC based Operator Work Station. The chlorination plant shall be located in C.W Chlorination building.

2.1.1 CALCULATION FOR PLANT CAPACITY (CW CHLORINATION SYSTEM)

CW and ACW Flow	=	87740 m^3/hr	
Chlorine dosing rate (shock)	=	5 ppm	
Total Chlorine consumption rate as per shock dose.	=	(87740 X 5)/1000 Kg./hr	
Chlorine requirement as per shock dose	=	438.7 Kg./hr	
Chlorinator selected based on shock dosing as per customer requirement	=	4 @ 150 kg/hr	[3W+1S]-Shock Dosing [1W+3S]-Cont. Dosing
Frequency and Period of shock dosing	=	0.5 hr in 8 hrs	
Daily Chlorine requirement as per shock dose	=	1.5 X438.7 Kg./hr	
	=	658.05 Kg/Day	
Chlorine requirement as per continuous dose		(87740 X 1)/1000 Kg./hr	
	=	87.74 Kg./hr	
Daily Chlorine requirement as per continuous dose	=	87.74 X 22.5 = 1974.15 Kg/Day.	
Total Chlorine requirement	=	658.05+ 1974.15 Kg/Day.	
	=	2632.2 Kg/Day.	
Tonner required per day (@900 Kg)	=	2632.2/900=2.92	
Tonner required for 15 days	=	15x2.92=43.8	
Tonner provided	=	46	

2.2 DESIGN PHILOSOPHY FOR RW CHLORINATION

Gas Chlorination Plant has been designed to dose required quantity of chlorine to Raw water system. Chlorine gas shall be mixed thoroughly with the water in the ejector provided in the system. The chlorine solution thus obtained shall be dosed in Stilling chamber of Pre Treatment Plant. System has been designed for continuous dosing at the rate of 5.0 ppm to control the microbiological growth. However, the actual dosing level shall be set by the operator based on residual chlorine at clarifier outlet. Provision shall be given to control the chlorination dosing rate through PLC based Operator Work Station. The chlorination plant shall be located in Chemical house of Pretreatment Plant..

2.2.1 CALCULATION FOR PLANT CAPACITY (RW CHLORINATION SYSTEM)

Raw Water Flow	=	1950 m^3/hr
Chlorine dosing rate (shock)	=	5 ppm
Total Chlorine consumption rate as per shock dose.	=	(1950 X 5)/1000 Kg./hr
Chlorine requirement as per shock dose	=	9.75 Kg./hr
Chlorinator selected based on shock dosing as per customer requirement	=	2 @ 10 kg/hr
Daily Chlorine requirement as per continuous dose	=	10 X 24 = 240 Kg/Day.
Total Chlorine requirement	=	240.0 Kg/Day.
Tonner required per day (@900 Kg)	=	240.0/900=0.27
Tonner required for 15 days	=	15x0.27=4
Tonner provided	=	8

2.2.2 EQUIPMENT DESIGN CRITERIA

Four (4) Nos. streams of gas chlorination system have been provided,. Each stream shall consist of the following main equipments & accessories:-

01

- Filled Chlorine ton containers,
- Expansion chamber.
- Pipe manifold with accessories
- Electrically heated water bath type Chlorine Evaporators.
- Chlorinator,
- CW injection booster pumps,
- Chlorine gas filters,
- Injector for chlorine solution preparation
- Chlorine gas leak detector & safety equipments.
- Chlorine gas absorption system
- Lifting & handling devices
- Associated piping & instrumentations.
- Necessary controls.

2.2.2.1 FILLED CHLORINE TON CONTAINER

Chlorine ton-containers (each of approximately 900 Kg, capacity) will be provided to store chlorine in liquid vapour phase. It shall be standard chlorine ton container. Each container will be complete with, roller support, built-in isolating valves (one (1) for liquid discharge and one (1) for gas withdrawal) and valve hood.

The design, fabrication and testing of cylinder/ton container shall conform to the Chief Controller of Explosives, Government of India, Department of Explosives. Nagpur.

2.2.2.2 EXPANSION CAHMBER

Expansion chamber of suitable capacity shall be provided on the common headers of the chlorine tonners. The expansion chamber will be complete with all necessary accessories such as pressure switch and rupture disc, etc.

Chamber of suitable capacity shall be supplied. An expansion chamber is to be provided on liquid line. The volume of the chamber shall be minimum 20% of the header pipe volume at highest elevated condition.

2.2.2.3 PIPE MANIFOLD WITH ACCESSORIES

Chlorine manifold consisting of straight lengths of pipe, fittings, isolation valves, automatic shut-off valves and liquid expansion chamber fitted with rupture discs, pressure indicator, Temperature indicator, pressure switch, alarms etc. will be provided. Pressure reducing & shut-off valves shall be provided in the chlorine gas line.

2.2.2.4 EVAPORATOR

Electrically heated constant temperature water bath type evaporator has been provided to vaporize liquid chlorine into the gas form before feeding the chlorinator. Each evaporator shall be sized with ample safety factor to allow for partial filling of the chlorine chamber. The electric heater shall be thermostatically controlled to maintain constant temperature. The hot water bath in the evaporator shall be vented to the atmosphere and the minimum water level in the water bath shall be maintained automatically by solenoid valve. Evaporator shall be provided with water level sight glass, gas temperature indicator, gas pressure gauge, low level alarm & switches, on / off switch with lamps, water temperature high switch, water temperature low switch etc., & other associated instrumentations as shown in the P&I enclosed and as per supplier's recommendation . Pressure regulating and Shut-off valves for each of the chlorine gas line from the outlet of each Evaporator shall be provided. Cathodic protection suitable to protect water bath tank and outside of evaporator shall be provided. A local ammeter shall be mounted on the evaporator as an indication of degree of cathodic protection.

2.2.2.5 CHLORINATOR

Vacuum solution feed type chlorinators shall be provided. Chlorine feed rate shall be manually adjusted. The chlorinator shall be provided with Rotameter and pressure and vacuum relief valve etc. The entire chlorinator shall be constructed of material completely resistant to the corrosive attack of wet or dry chlorine gas & chlorine solution.
The chlorinator shall be designed to operate with the capacity ratio of 20:1

2.2.2.6 CW INJECTION BOOSTER WATER PUMPS

4 Nos. booster pumps shall be provided to supply makeup water for the chlorination plant. Pump shall be complete with suction strainers & pressure gauge at the inlet, non-return valves, isolating gate valves, pressure gauges etc. at the discharge side.

2.2.2.7 EJECTOR

Both water and chlorine gas shall be thoroughly mixed in the ejector and chlorine solution is then dosed at the required dosing point.

2.2.2.8 DIFFUSER

Diffuser shall be designed to dose concentrated chlorine solution in required quantity at each dosing point. The diffuser shall be provided as per system requirement. Perforated type diffuser shall be designed so that each hole takes a 1 to 2 gpm (4 to 7 LPM) at 3 to 4 M/sec velocity.

2.2.2.9 HOIST MONO-RAILS

An electrically hoist operated block with trolley shall be provided for lifting the ton container. Lifting bar to grab the empty or full ton container during handling (1 No.) shall have suspension type load indicator of minimum capacity (Net) 3000 Kg. Scale shall have tare adjustment so that amount of chlorine can be read directly. Scale shall also have a crane lock with 360 Deg swivel.

2.2.2.10 WEIGHING SCALE

One weighing scale of 0 to 3 tonne capacity of platform dial type shall be provided near the entrance of the tonner storage area for weighing the ton containers. Weighing scale shall be suitable for fixing on the ground.

2.2.2.11 OTHER MISC. ACCESSORIES

System shall also have following:

- Associated piping and valves required for the system.
- All necessary instruments and controls required for easy and safe operation of the system.

2.2.2.12 SAFETY & SUPERVISORY INSTRUMENT

a) GAS MASK & OXYGEN BREATHING EQUIPMENT

Two (2) nos. of Gas mask along with breathing apparatus tank complete with full mask, full vision face pieces, air flow regulating valves & all accessories shall be provided. In addition to above, Two (2) nos. canister type breathing apparatus shall be provided in which moisture content from the wearer exhaled air react with granular chemical in breathing apparatus & liberates oxygen. The released oxygen enters a breathing bag from which the wearer can inhale.

b) EMERGENCY SHOWER

Two (2) nos. (One (1) for chlorinator room & one (1) for tonner storage room) of emergency shower with eye wash in the plant room for personnel safety shall be provided. The Shower shall be fitted in a pipe of minimum 40 mm NB & shall be foot operated.

c) CHLORINE DETECTOR

Sixteen (16) numbers Quick reaction Chlorine gas leak detector for audio-visual alarm for detecting chlorine leaks in the rooms shall be provided as described below:

- Fourteen (14) numbers in Chlorine Ton container storage room each with two sensors.
- Two (2) number for Chlorinator Room each with two sensors.

d) EMERGENCY KIT FOR SEALING

For attending chlorine leaking from tonner, emergency kit shall be provided containing container tools like gaskets, yokes, hoods, clamps, studs, tie tools, mild steel channels, spanners, screws to fit chlorine container. The gasket shall be designed to control / stop leakages from chlorine containers, valves & chlorine container fusible plugs. The accessories shall conform to the details specified by alkali manufacturers' association / chlorine institute, U.S.A. Numbers shall be as indicated in specification and Chlorine Institute Manual.

Following shall also be included in the scope of supply. Refer Data Sheet-A for nos. and specification.

1. Orthotolidine impregnated Leak detector.
2. Ammonia bottles.
3. Moisture absorbing breathing Bottles.
4. Chlorine residual kit.
5. Weather cock.
6. Safety Helmet.
7. Goggles.
8. Rubber Boots.
9. Gloves.
10. Colored Vest.

2.2.3 CHLORINE LEAK ABSORPTION SYSTEM

An automatic chlorine leak absorption system has been provided for CW Chlorination plant for the tonner in service. The chlorine leak absorption system shall absorb leaked chlorine from the hood by means of blowers provided at the end of the duct. In the event of leakage in chlorine ton container, the alkali recirculation pump and fan shall start automatically by a signal from leak detector. The blower shall suck the leaked chlorine gas through FRP Hood & duct and shall direct chlorine to the absorption tower bottom. In the absorption tower chlorine shall be absorbed by the circulating alkali solution. The chlorine leak absorption system shall be sized for absorption & neutralisation of about one chlorine cylinder leakage within one hour (max).

Minimum capacity of each caustic solution tank shall be suitable to absorb one (1) No. of completely leaked chlorine ton container plus 20% margin. Caustic concentration in tank shall not exceed 20% W/V. Each tank shall be provided with caustic charging platform with handrails & staircase, level gauges, overflow, drain with double valves, sampling connection, level switches, water filling connection etc.

The absorption system shall mainly comprise of:

- 16 Nos. of FRP Hood covering full portion of the tonner in service and duct.
- 2 Nos. (1 working + 1 stand-by) Blowers.
- 2 Nos. Exhaust Fans in chlorinator room.
- One (1) no. absorption tower (FRP) with packing.
- One (1) no. alkali storage tank.
- 2x100% (1 working + 1 standby) alkali circulating pumps.
- Interconnecting piping valves, ducts, control and instrumentation.

Capacity of each exhaust fans provided in the chlorinator room for normal circulation of fresh air shall be based on a complete air change requirement of chlorination room for 20 air changes per hour. Ducting work shall be designed based on an air velocity of 10.0 M/Sec. All the associated interlocks will be provided such that the system starts automatically by a signal from leak detector.

2.2.4 LAYOUT CONSIDERATION

CW Chlorination Plants shall be located in a CW Chlorination building adjoining CW pump house. CW Chlorination building shall have independent rooms for chlorinators, booster pumps, OWS and Chlorine Ton Container. Chlorine leak absorption system shall be located outdoor adjoining chlorination plant building in open area. No side walls shall be provided for the chlorine tonner area & hoist arrangement shall be so designed that the tonner can be lifted straight from the truck. Complete installation including chlorine ton container & valves and the chlorination plant layout shall meet the requirement of the Chief Controller of Explosive, Nagpur, India & any other statutory regulation as applicable. Necessary approval from the explosive Department, Nagpur, shall be obtained.

3.1 EQUIPMENT DESIGN CRITERIA (RW CHLORINATION SYSTEM)

Two (2) Nos. streams of gas chlorination system have been provided,. Each stream shall consist of the following main equipments & accessories:-

- Filled Chlorine ton containers,
- Expansion tank
- Pipe manifold with accessories
- Chlorinator,
- Clarified water injection booster pumps,
- Chlorine gas filters,
- Injector for chlorine solution preparation
- Chlorine gas leak detector & safety equipments.
- Chlorine gas absorption system
- Lifting & handling devices
- Associated piping & instrumentations.
- Necessary controls.

3.1.1 CHLORINE TON CONTAINER

Chlorine ton-containers (each of approximately 900 Kg, capacity) will be provided to store chlorine in liquid vapour phase. It shall be standard chlorine ton container. Each container will be complete with, roller support, built-in isolating valves (one (1) for liquid discharge and one (1) for gas withdrawal) and valve hood.

The design, fabrication and testing of cylinder/ton container shall conform to the Chief Controller of Explosives, Government of India, Department of Explosives. Nagpur.

3.1.2 PIPE MANIFOLD WITH ACCESSORIES

Chlorine manifold consisting of straight lengths of pipe, fittings, isolation valves, automatic shut-off valves and liquid expansion chamber fitted with rupture discs, pressure indicator, Temperature indicator, pressure switch, alarms etc. will be provided. Pressure reducing & shut-off valves shall be provided in the chlorine gas line.

3.1.3 EXPANSION CAHMBER

Expansion chamber of suitable capacity shall be provided on the common headers of the chlorine tonners. The expansion chamber will be complete with all necessary accessories such as pressure switch and rupture disc, etc.

Chamber of suitable capacity shall be supplied. An expansion chamber is to be provided on liquid line. The volume of the chamber shall be minimum 20% of the header pipe volume at highest elevated condition.

3.1.4 CHLORINATOR

Vacuum solution feed type chlorinators shall be provided. Chlorine feed rate shall be manually adjusted. The chlorinator shall be provided with Rotameter and pressure and vacuum relief valve etc. The entire chlorinator shall be constructed of material completely resistant to the corrosive attack of wet or dry chlorine gas & chlorine solution.

The chlorinator shall be designed to operate with the capacity ratio of 20:1

3.1.5 BOOSTER WATER PUMPS

2 Nos. booster pumps shall be provided to supply makeup water for the chlorination plant. Pump shall be complete with suction strainers & pressure gauge at the inlet, non-return valves, isolating gate valves, pressure gauges etc. at the discharge side.

3.1.6 3.1EJECTOR

Both water and chlorine gas shall be thoroughly mixed in the ejector and chlorine solution is then dosed at the required dosing point.

3.1.7 DIFFUSER

Diffuser shall be designed to dose concentrated chlorine solution in required quantity at each dosing point. The diffuser shall be provided as per system requirement.Perforated type diffuser shall be designed so that each hole takes a 1 to 2 gpm (4 to 7 LPM) at 3 to 4 M/sec velocity.

3.1.8 HOIST MONO-RAILS

An electrically hoist operated block with trolley shall be provided for lifting the ton container. Lifting bar to grab the empty or full ton container during handling (1 No.) shall have suspension type load indicator of minimum capacity (Net) 3000 Kg. Scale shall have tare adjustment so that amount of chlorine can be read directly. Scale shall also have a crane lock with 360 Deg swivel.

3.1.9 WEIGHING SCALE

One weighing scale of 0 to 3 tonne capacity of platform dial type shall be provided near the entrance of the tonner storage area for weighing the ton containers. Weighing scale shall be suitable for fixing on the ground.

3.1.10 OTHER MISC. ACCESSORIES

System shall also have following:

- Associated piping and valves required for the system.
- All necessary instruments and controls required for easy and safe operation of the system.

3.1.11 SAFETY & SUPERVISORY INSTRUMENT

a) GAS MASK & OXYGEN BREATHING EQUIPMENT

Two (2) nos. of Gas mask along with breathing apparatus tank complete with full mask, full vision face pieces, air flow regulating valves & all accessories shall be provided. In addition to above, Two (2) nos. canister type breathing apparatus shall be provided in which moisture content from the wearer exhaled air react with granular chemical in breathing apparatus & liberates oxygen. The released oxygen enters a breathing bag from which the wearer can inhale.

b) EMERGENCY SHOWER

Two (2) nos. (One (1) for chlorinator room & one (1) for tonner storage room) of emergency shower with eye wash in the plant room for personnel safety shall be provided. The Shower shall be fitted in a pipe of minimum 40 mm NB & shall be foot operated.

c) CHLORINE DETECTOR

Three (03) numbers Quick reaction Chlorine gas leak detector for audio-visual alarm for detecting chlorine leaks in the rooms shall be provided as described below:

- Two (02) numbers in Chlorine Ton container storage room each with two sensors.
- One (01) number for Chlorinator Room each with two sensors.

d) EMERGENCY KIT FOR SEALING

For attending chlorine leaking from tonner, emergency kit shall be provided containing container tools like gaskets, yokes, hoods, clamps, studs, tie tools, mild steel channels, spanners, screws to fit chlorine container. The gasket shall be designed to control / stop leakages from chlorine containers, valves & chlorine container fusible plugs. The accessories shall conform to the details specified by alkali

manufacturers' association / chlorine institute, U.S.A. Numbers shall be as indicated in specification and Chlorine Institute Manual.

Following shall also be included in the scope of supply. Refer Data Sheet-A for nos. and specification.

11. Orthotolidine impregnated Leak detector.
12. Ammonia bottles.
13. Moisture absorbing breathing Bottles.
14. Chlorine residual kit.
15. Weather cock.
16. Safety Helmet.
17. Goggles.
18. Rubber Boots.
19. Gloves.
20. Colored Vest.

3.1.12 CHLORINE LEAK ABSORPTION SYSTEM

An automatic chlorine leak absorption system has been provided for RW Chlorination plant for the tonner in service. The chlorine leak absorption system shall absorb leaked chlorine from the hood by means of blowers provided at the end of the duct. In the event of leakage in chlorine ton container, the alkali recirculation pump and fan shall start automatically by a signal from leak detector. The blower shall suck the leaked chlorine gas through FRP Hood & duct and shall direct chlorine to the absorption tower bottom. In the absorption tower chlorine shall be absorbed by the circulating alkali solution. The chlorine leak absorption system shall be sized for absorption & neutralisation of about one chlorine cylinder leakage within one hour (max).

Minimum capacity of each caustic solution tank shall be suitable to absorb one (1) No. of completely leaked chlorine ton container plus 20% margin. Caustic concentration in tank shall not exceed 20% W/V. Each tank shall be provided with caustic charging platform with handrails & staircase, level gauges, overflow, drain with double valves, sampling connection, level switches, water filling connection etc.

The absorption system shall mainly comprise of:

- 02 Nos. of FRP Hood covering full portion of the tonner in service and duct.
- 2 Nos. (1 working + 1 stand-by) Blowers.
- 2 Nos. Exhaust Fans in chlorinator room.
- One (1) no. absorption tower (FRP) with packing.
- One (1) no. alkali storage tank.
- 2x100% (1 working + 1 standby) alkali circulating pumps.
- Interconnecting piping valves, ducts, control and instrumentation.

Capacity of each exhaust fans provided in the chlorinator room for normal circulation of fresh air shall be based on a complete air change requirement of chlorination room for 20 air changes per hour. Ducting work shall be designed based on an air velocity of 10.0 M/Sec. All the associated interlocks will be provided such that the system starts automatically by a signal from leak detector.

3.1.13 LAYOUT CONSIDERATION

RW Chlorination Plants shall be located in a Chemical house of Pre-treatment Plant. Chemical House of Pre-treatment Plant shall have independent rooms for chlorinators, booster pumps, OWS and Chlorine Ton Container. Chlorine leak absorption system shall be located outdoor adjoining Chemical House in open area. No side walls shall be provided for the chlorine tonner area & hoist arrangement shall be so designed that the tonner can be lifted straight from the truck. Complete installation including chlorine ton container & valves and the chlorination plant layout shall meet the requirement of the Chief Controller of Explosive, Nagpur, India & any other statutory regulation as applicable. Necessary approval from the explosive Department, Nagpur, shall be obtained.

SECTION-D2

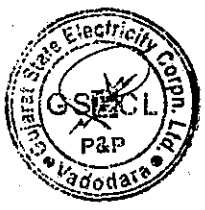
(GENERAL TECHNICAL REQUIREMENT FOR ELECTRICAL)

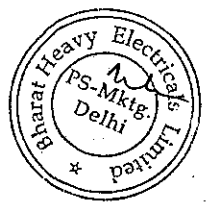
1.1 GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS (NO OF SHEET=26)
1.2 CABLE SCHEDUEL FORMAT AND CABLE DETAILS (NO OF SHEET=3)

VOLUME : IIF/1

SECTION-II

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





CONTENT

Bharat Heavy Electricals Limited
PS-Mktg.
Delhi

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

Bharat Heavy Electricals Limited PS-Mktg-Delhi
Gujarat Electricity Corpn. Ltd. Vadodara

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.

Bharat Heavy Electricals Limited PS-Mktg. Delhi
Gujarat State Electricity Corp. Ltd. GSECL P&P Vadodara 088

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 hardwares 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.

Bharat Heavy Electricals Limited PS-Mktg. Delhi

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 / thermisters 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**

Bharat Heavy Electricals Limited PS-Mktg. Delhi

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 to test, provided the test motor is identical to motor being supplied.

Bharat Heavy Electricals Limited PS-Mktg. Delhi

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

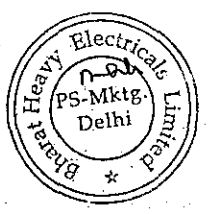
g) Complete motor data

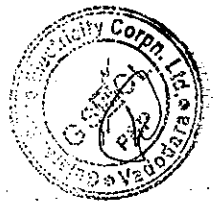
h) Erection & Maintenance Manual

Bharat Heavy Electricals Limited
PS-Mktg.
Delhi

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 including160KW
	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 : ± 10% Frequency : ± 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 :

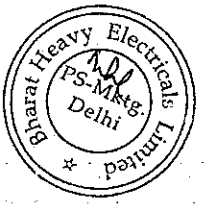
Voltage : 187 to 242 Volt

Bharat Heavy Electricals Limited PS-Mktg. Delhi

VOLUME : IIF/1

SECTION-III

TECHNICAL SPECIFICATION FOR ELECTRIC MOTOR ACTUATORS



CONTENT

Bharat Heavy Electricals Limited PS-Mktg. Delhi

Gujarat State Electricity Corpn. Ltd. Vadodara

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.

Bharat Heavy Electricals Limited PS-Mktg. Delhi

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.

Bharat Heavy Electricals Limited PS-Mktg. Delhi

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.

Bharat Heavy Electricals Limited PS-Mktg. Delhi
Gujarat Electricity Corpn. Ltd. Vadodara

LT MOTORS

A. GENERAL

1. Manufacturer & Country of origin.
(Shall be as per approved QA make)

2. Equipment driven by motor

3. Motor type

4. Quantity

B. DESIGN AND PERFORMANCE DATA

1. Frame size

2. Type of duty

3. Type of enclosure /Method of cooling/Degree of protection

4. Applicable standard to which motor generally conforms

5. Efficiency class as per IS 12615

6. (a) Whether motor is flame proof Yes/No

   (b) If yes, the gas group to which it conforms as per IS:2148

7. Type of mounting

8. Direction of rotation as viewed from DE END__

9. Standard continuous rating at 40 deg.C. ambient temp. as per Indian Standard (KW)

10. Derated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW)

11. Maximum continuous load demand of driven equipment in KW

12. Rated Voltage (volts)

13. Permissible variation of :

a. Voltage (Volts)

b. Frequency (Hz)

c. Combined voltage and frequency

14. Rated speed at rated voltage and frequency(RPM)

15. At rated Voltage and frequency:

a. Full load current

b. No load current

16. Power Factor at

a. 100% load

b. NO load

c. Starting.

17. Efficiency at rated voltage and frequrecy,

a. 100% load

b. 75% load

c. 50% load

18. Starting current (amps) at

a. 100 % voltage

b. 85% voltage

c. 80% voltage

19. Minimum permissible starting Voltage (Volts)

20. Starting time with minimum permissible voltage

a. Without driven equipment coupled

b. With driven equipment coupled

21. Safe stall time with 100% and 110% of rated voltage

    a. From hot condition

    b. From cold condition

22. Torques :

    a. Starting torque at min. permissible voltage(kg-mtr.)

    b. Pull up torque at rated voltage.

    c. Pull out torque

    d. Min accelerating torque (kg.m) available

    e. Rated torque (kg.m)

23. Stator winding resistance per phase (ohms at 20 Deg.C.)

24. GD^2 value of motors

25. No of permissible successive starts when motor is in hot condition

26. Locked Rotor KVA Input

27. Locked Rotor KVA/KW

28. Vibration limit :Velocity (mm/s)

29. Noise level limit (dBA)

C. CONSTRUCTIONAL FEATURES

1. Stator winding insulation

    a. Class & Type

    b. Winding Insulation Process

    c. Tropicalised (Yes/No)

d. Temperature rise over specified maximum ambient temperature of 50 deg C

e. Method of temperature measurement

f. Stator winding connection

2. Main Terminal Box

a. Type

b. Location (viewed from NDE side)

c. Entry of cables(bottom/side)

d. Recommended cable size (To be matched with cable size envisaged by owner)

e. Fault level (MVA), Fault level duration (sec)

f. Cable glands & lugs details (shall be suitable for power cable)

3. Type of DE/NDE Bearing

4. Motor Paint shade

5. Weight of

a. Motor stator (KG)

b. Motor Rotor (KG)

c. Total weight (KG)

D. List of accessories.

1. Space Heaters (Applicable for 30 KW & above motor) (Nos./Power in watts/supply voltage)

2. Terminal Box for Space Heater (Yes/No)

3. Speed switch (Yes/No)
No of contacts and contact ratings of speed switch

4. Insulation of bearing (Yes/No)

5. Noise reducer(Yes/No)

6. Grounding pads

   i) No and size on motor body

   ii) Nos on terminal Box

7. Vibration pads

   i) Nos and size

   ii) Location

8. Any other fitments

E. List of curves.

1. Torque speed characteristic of the motor

2. Thermal withstand characteristic

3. Starting. current Vs. Time

4. Starting. current Vs speed

5. P.F. and Effi. Vs Load

F. Additional Data to be filled for each rating of DC Motor

1. Rated armature voltage (Volt)

2. Rated field excitation (Amp)

3. Permissible % variation in voltage

4. Minimum Permissible Starting voltage (volt)

5. At rated voltage

   i) Full load Armature current.(Amp)

   ii) Full load Field current (Amp)

iii) No load Armature current (Amp)

6. Full load Field current (Amp)

7. No load Aramature current (Amp)

8. Minimum permissible field current(Amp) to avoid overspeeding at

   i) Maximum permissible voltage

   ii) Rated voltage

   iii) Minimum Permissible Voltage

9. Resistance (indicative Values) in ohm

   i) Armature winding (Arm + IP + Series) at 25 deg.C

   ii) Field Winding at 25 deg. C

10. Inductance (indicative values)

    i) Armature winding

    ii) Field winding

11. Value of trimmer resistance (ohm) to be connected in series with the shunt field to obtain rated speed at

    i) 220 V DC

    ii) 250 V DC

    iii) 187 V DC

12. Value of the external resistance (ohm) required to be connected in series with armature during starting only

13. Technical data sheet for external resistance box

14. GA drawing of motor

15. Starting time calculation

16. Starter resistance design calculation

17. Electrical connection diagram of motor

CABLE SCHEDULE FORMAT **ANNEXURE III**

UNITCABLENO	FROM	TO	PURPOSE	CABLE SCOPE (BHEL PEM/ VENDOR)	REMARKS	CABLESIZE	PATHCABLENO	TENTATIVE CABLE LENGTH

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

(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

SECTION-D3

(GENERAL TECHNICAL REQUIREMENT FOR C&I)

TABLE OF CONTENTS

GENERAL & SPECIFIC TECHNICAL REQUIREMENT

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 In case of any contradiction most stringent clause/condition shall prevail..

6.0 Separate PLCs/FURNITURE/OWS/PRINTERS etc. for RW and CW Chlorination is to be provided (please refer specific requirements for RW and CW chlorination)

7.0 Mandatory spares for both the PLCs/OWS/UPS etc. (separate for RW and CW Chlorination) shall be provided separately.

8.0 Separate UPS(as per specification attached elsewhere in this specification) shall be provided for both RW and CW chlorination system.

1.00.00 **GENERAL**

1.01.00 In conformity with the guidelines provided in the specification, the scope of works shall completely cover all Instrumentation & Control equipment, functions, activities and documentation specified under the accompanying Technical Specifications and shall not be limited to the following:

a) Detailed design and engineering of the manufactured equipment; system integration and system engineering.

b) Complete manufacture including shop testing before shipment.

c) Specifying, procurement, quality inspection of bought-out items from sub-suppliers. Design co-ordination for and integration with bought-out items.

d) Coordination, integration and interface between various BOP control systems such as Water Pretreatment plant, Demineralized Water plant, Coal Handling Plant, Ash Handling Plant, ETP etc. and the station DCS for centralized monitoring & selective operation.

e) Providing engineering drawings, documents, licensed copy of software and developmental tools, data, instruction, operation and maintenance manual etc. for Owner's review / approval / record.

f) Arranging for Owner's inspection and testing of manufactured as well as bought-out items at the respective works.

g) Packaging and transportation of instruments, equipments, accessories and erection hardware from the manufacturer's works to the site, including transit insurance.

h) Pre-assembly (if any), erection, testing and commissioning of all equipments and instruments supplied, in totality.

i) Performing availability tests, Performance and Guarantee tests.

j) Prepare and submit approved & as-built drawings and documents in hard and soft copies.

k) Furnishing of spares, tools and tackle and test instruments.

l) Fulfilling post-commissioning liabilities.

m) Arranging for the training of Owner's personnel of different categories at manufacturer's works as well as plant site.

n) Other activities detailed in subsequent sections of the Specification.

o) Any other activity, not mentioned explicitly, but felt essential by Bidder for successful completion of work.

1.02.00 Requirements enumerated in this specification are qualitative in nature and are based on typical configuration of various BOP plants for the purpose of bidding. It shall be the responsibility of Bidder to offer Instrumentation &

Control system to meet the actual functional requirements of the BOP systems offered.

1.03.00 Operation and control of various BOP systems like Water system, Coal Handling plant, Ash Handling plant, Compressed air system, Ventilation & AC system, DM plant, PT plant,CW treatment system, DG set, , Fuel unloading system etc. shall be carried out from redundant PLC / Microprocessor based control system. There may be other systems where control is not critical. In such cases hardwired / relay based interlock shall be envisaged.

However, hardware based monitoring / control / annunciation shall be provided for the systems where HMI workstations are not envisaged or need for such back up is strongly recommended by Bidder for the safe shutdown of the BOP systems.

1.04.00 In case of any conflict or contradiction between any two or more sections of this specification the more stringent condition shall generally be applicable. Owner, however, reserves the right to relax this condition at his discretion.

1.05.00 Type of control vis-a vis the plant area are delineated below

1.05.01 Plant Auxiliaries System:

a) DM Cooling Water System & process Heat exchangers

b) Condenser Cooling Water (CW system) with tube cleaning system.

c) Auxiliary Cooling Water System (ACW system) with self-cleaning strainers.

d) Condensate Transfer (CT) pump

e) DM Service Water (DMSW) pumps

f) Mill Reject Handling System

g) Fuel Oil Pressurizing & Heating System

h) Condensate On-line Polishing Unit

i) Chemical Feed system

1.05.02 Interface with Other Off site Plants under BOP Package

Data acquisition / indication of selected parameters / selective operation (as required) from the following off site plants to station DCS are foreseen through MODBUS / OPC protocol:

a) Pretreatment Plant;

b) Demineralization Plant;

c) Coal Handling plant;

d) Fuel Oil Unloading & Storage;

e) Turbine Oil Purification system;

f) ETP Plant;

g) Ash Handling Plant;

h) Fire sensing and protection system;

i) Compressed air system;

j) AC & Ventilation System.

1.05.03 Off Site Plants shall be operated from their local control stations located in the respective plant local control rooms. Some of the Plants shall have limited operational facility from Central Control Room as well.

1.05.04 All PLC based based control systems for plant auxiliaries and other offsite plants shall be powered from separate redundant UPS. Local control panels for such systems shall be kept in air condition environment.

~~1.05.05~~ ~~Control matricx for the Auxiliaary system & off-site systems shall be in general as below:~~

~~SL. NO.~~	~~AUX.SYSTEM / PLANT~~	~~CONTROL SYSTEM~~	~~CONTROL LOCATION~~	~~DCS INTERFACE~~
~~**A.**~~	~~**Plant Auxiliaries System**~~			
~~a)~~	~~DM Cooling Water System (Turbine)~~	~~DCS~~	~~DCS Monitoring & Operation from Central Control Room~~	
~~b)~~	~~DM Cooling Water System (Boiler)~~	~~DCS~~	~~DCS Monitoring & Operation from Central Control Room~~	
~~c)~~	~~CW system~~	~~Through Remote I/O Cabinet to DCS~~	~~DCS Monitoring & Operation from Central Control Room~~	
~~d)~~	~~ACW system~~	~~Through Remote I/O Cabinet to DCS~~	~~DCS Monitoring & Operation from Central Control Room~~	
~~e)~~	~~Condenser tube cleaning system~~	~~PLC~~	~~Local operating panel .~~	~~Hardware connectivity for alarm and monitoring.~~
~~f)~~	~~Mill Reject Handling~~	~~Redundant PLC~~	~~Operator stations in local~~	~~MODBUS Soft link for~~ remote

SL. NO.	AUX.SYSTEM / PLANT	CONTROL SYSTEM	CONTROL LOCATION	DCS INTERFACE
			Control Room	monitoring
f)	Instrument Air & Service Air Compressors & air drying plant	Microprocessor based control for each compressor with master controller	Individual unit with operator interface & PC based master Operating Staion with 24" TFT monitor in Compressor Room.	MODBUS Soft link for remote monitoring
g)	Fire sensing and protection system for Entire Plant.	Microprocessor based Intelligent Detectors & PLC based Fire Water Pump control System	Microprocessor based Main Fire Alarm Panel in Control Room & Loacl panel in Fire Water Pump House. One repeater Fire Alarm Panel in existing Fire Station and depending on distance cabling interface shall be decided by Bidder.	Hard wired interface to DCS for monitoring and status indication.
h)	Pretreatment Plant	Redundant PLC	Within the boundary limit of PTPlant	MODBUS Soft link for remote monitoring

NOTE: As per concept of integration of control system Bidder may consider propriatory control systems as integrated part of DCS.

1.05.06 Considering the high ambient noise and electromagnetic interference prevailing in power plant, communication links between off-site controls and plant DCS shall be based on Optical Fiber Communication (OFC) alog with necessary hardware at both ends.

2.00.00 **DESIGN PHILOSOPHY**

2.01.00 General design philosophy outlined in Vol IIE Section 1 of the specification shall apply to plant auxiliaries as well.

2.02.00 PLC systems shall be time synchronized with the GPS Master Clock. Bidder shall arrange for the necessary ports ans cable for the purpose as well.

3.00.00 **INSTRUMENT & SYSTEM PHILOSOPHY**

3.01.00 Fuel Oil Pressurising & Heating System

SPECIFICATION FOR MOTORISED VALVE ACTUATOR

BHEL	**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 1 OF 3

Data Sheet A & B

408

		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
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	

BHEL	**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

408

		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	@ 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	

BHEL	**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 :----------	

BHEL	**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 INTERNATION 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.

.

	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL
NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @= TO BE FILLED BY ES