# TAMILNADU GENERATION & DISTRIBUTION CORPORATION LTD

# RENOVATION, MODERNISATION & UPRATING OF KODAYAR POWER HOUSE-I FROM 1 x 60 MW TO 1 X 70 MW

# TECHNICAL SPECIFICATION FOR RENOVATION WORK FOR DOUBLE GIRDER EOT CRANE-135/20T

**SPECIFICATION NO.: PE-TS-470-501-A001 Rev 0**


**BHARAT HEAVY ELECTRICALS LIMITED**

**POWER SECTOR**

**PROJECT ENGINEERING MANAGEMENT**

**NOIDA, INDIA**

## INDEX

# SECTION I
# SPECIFIC TECHNICAL REQUIREMENTS

## 1. INTENT OF SPECIFICATION

1.1 This specification includes, but not limited to 'Supply part' & 'Service part' comprising of provision of all labour, plant , materials and performance of all work necessary for assessment of the existing crane, reverse engineering , site measurements on existing structures & equipment in order to determine site limitations & constraints, dismantling , detail design and engineering, manufacturing, testing, quality assurance, quality control, shop assembly, shop testing, transportation, delivery of all equipment's required for refurbishment, storage of items & preservation, erection, testing and commissioning including performance testing, field acceptance test, training of employer's personnel, handing over and guarantee(as per relevant clauses of NIT, SCC & GCC), complete with accessories, spare parts and warranting a trouble free safe operation of the installation as per requirement given in NIT **for refurbishment of 1 no. 135/20T Double Girder EOT crane of Power House** for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.

1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. **Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor of the responsibility of providing such facilities to complete the supply and services of the cranes and its accessories**.

1.3 It is not the intent to specify herein all the details. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.

1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.

1.5 The general term and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.

1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Section-III of the specification **within 10 days of receipt of tender documents.** In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser/Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.

1.8 Deviations, if any, should be very clearly brought out clause by clause in the enclosed deviation schedule along with cost of withdrawal; otherwise, it will be presumed that the vendor's offer is

strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/its customer.

1.9 In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, more stringent requirement as per the interpretation of the owner shall apply.

1.10 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.

1.11 Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder /vendor and Customer/ Purchaser/Employer will mean BHEL and /or customer including their consultant as interpreted by BHEL in the relevant context. For details refer the relevant clause in GCC.

1.12 Quality plan for reference is included in this specification to enable the bidder to understand the extent of inspection and testing requirements to execute this job. The successful bidder has to follow the quality plan's minimum requirement during manufacturing and testing.

1.13 Bidder shall visit site and satisfy himself of all details including facilities at site before quoting for the equipment and services. No claim on this account shall be admissible in this regard.

Note:

Bidder to note that BHEL reserves the right for drawing/document submission through web based Document Management System. Bidder would be provided access to the DMS for drawing/document approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end.

- Internet explorer version – Minimum Internet Explorer 7.
- Internet speed – 2 mbps (Minimum preferred).
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked.
- Vendor's internal proxy setting should not block DMS application's link (https://www.bhelpem.com/WrenchWeb/

1.0.0. SCOPE OF WORK

**1.1.0** Scope shall covers the provision of all labour, plant , materials and performance of all work necessary for assessment of existing cranes, reverse engineering , site measurements on existing structures & equipment in order to determine site limitations & constraints, dismantling , detail design and engineering, manufacturing, testing, quality assurance, quality control, shop assembly, shop testing, transportation, delivery of all equipment's required for refurbishment, erection, testing and commissioning including performance testing, field acceptance test, training, handing over to the Employer and guarantee(as per relevant clauses of NIT, SCC & GCC), complete with accessories, spare parts and warranting a trouble free safe operation of the installation.

1.1.1 Equipment and services to be furnished by the bidder for the refurbishment of EOT CRANE of Power House with accessories as per the details given. Any equipment / accessories not specified but required for refurbishment of the EOT cranes for efficient operation shall also be under the bidder's scope of work.

**DESCRIPTION OF EXISTING CRANES**

| S. No. | **Description** | **135/20T Double Girder EOT crane.** | | | |
|---|---|---|---|---|---|
| 1 | **Area/ Duty** | Power house / Indoor | | | |
| 2 | **Number of cranes** | One (1) no. | | | |
| 3 | **Capacity** | 135T Main Hook and 20T Auxiliary Hook | | | |
| 4 | **Span** | 13.106 m (approx) | | | |
| 5 | **Bay length** | 33 m (approx) | | | |
| 6 | **Crane classification** | Class I (M3 Class as per new Classification to IS 3177) for Mechanical & Electrical. | | | |
| 7 | **Make** | M/s. Hindustan Motor Ltd, Calcutta/1968 | | | |
| 8 | Operation | Cabin | | | |
| 9 | Condition of crane | Working | | | |
| 10 | Main hoist/Aux hoist Elevations | RL 370.650 m | | | |
| 11 | **Lift (Main hoist/Aux hoist)** | Approximately 20 m Main Hook / 22 m Auxiliary Hook | | | |
| 12 | **Ambient Temperature** | 10 °C to 40 °C | | | |
| 13 | **Power supply** | 415 V AC, 3-Ø, 50 Hz | | | |
| 14 | **Control supply** | 220 V AC, 1-Ø, 50 Hz | | | |
| 15 | **Conforming to Standard** | IS:3177 (Edition 2020) for replacement parts. | | | |
| 16 | **No. of CT wheels** | 4 nos. | | | |
| 17 | **No. of LT wheels** | 8 nos. | | | |
| 18 | **Motors** | Long travel | Cross Travel | Main Hoist | Auxiliary Hoist |
| | **Make** | Associated Ele. Industries | | | |
| | **HP** | 35 | 7 | 40 | 24.5 |
| | **Rating** | ½ Hour | | | |
| | **RPM** | 965 | 910 | | 965 |
| | **Voltage** | 400/440 | 400/440 | 400/440 | 400/440 |
| | **Amp** | 49 | 22 | 56 | 35 |

**1.1.2 Scope of supply:** The scope of supply for refurbishment work for the cranes shall include the following: The rating of components to be replaced shall be of at least minimum rating of the particular items installed at site.

1. Replacement of wire ropes and refurbishing of hoist machinery (gears, gear boxes, sheaves, wheels etc.)
2. Replacement of power conductors (down shop and/or trolley and bridge). PVC shrouded bus bar (Copper) DSL for long travel and Copper conductor flexible trailing cable/ Energy chain for cross travel.
3. Replace/provide power disconnecting devices to meet current standards.
4. Replacement of mechanical load brakes with electrical load brakes. Brakes to be provided shall be Thruster and electromagnetic type along with brake drums. 1 nos. of each type of brakes shall be provided for each motor.
5. Replacement of motors suitable for resistance box control. Motors shall be slip ring type. Alternatively, for Cross and Long Travel, squirrel cage induction motor with VVVF (variable voltage variable frequency) drive can be used.
6. Replacement of control systems. Radio remote control shall be provided in addition to existing cabin control.
7. Replacement of control and power wiring or conductor and collector systems. All cables shall be copper of minimum 2.5 sq. mm.
8. Replacement of lighting system. All under bridge lights, over bridge lights and cabin lights shall be replaced with LED lights. Rating of lights shall be as given below:
   a) 125 W LED lights for under bridge
   b) 40 W LED lights for over bridge
   c) 10 W LED lights for cabin.
9. Refurbishment/ replacement of end stopper.
10. Re-painting before erection.
11. Load test by certified agency.
12. Commissioning of the Crane.
13. Lubricating oil in the gear boxes shall be replaced. Lubrication/greasing shall be done for the crane as per the existing lubrication system.
14. Load testing of crane shall be done as per IS 3177 at site. For load test the heaviest Assembly during assembling of TG components/ equipment's shall be used for load testing.
15. Painting of complete crane including girders, lifting beam (if any) after cleaning the complete surface with suitable cleaner shall be done. (refer Annexure-I for the applicable painting schedule).
16. Bought out items listed in the Customer's specification shall be followed for make of various items to be replaced. In case of vendors or items not appearing in the preferred makes list, prior approval from M/s TANGEDCO shall be sought by furnishing the credentials of the vendors before proceeding.

1.1.3 **Mandatory Spares**

A complete unused and new set of Mandatory Spare parts shall be supplied. Each part shall be stamped so as to be identified, easy for it use. The items supplied shall be of the best quality. The requirement of mandatory spare parts is listed in Annexure –II Section-I of this specification.

1.1.4 **Erection & Commissioning spares; Maintenance Tools and Tackles**

The Bidder shall supply erection & commissioning spares, Maintenance Tools and Tackles as per his experience, for replacement of damaged or unserviceable parts during the execution of the project at site, to avoid delay in the project schedule. This shall form part of

the main equipment supply. Oil and grease required for first filling along with ten (10%) percent excess quantity. The bidder shall deliver to the Owner all equipment complete with initial fill of fluids, grease or lubricants, in drums / containers. Bidder shall supply minimum following.

1.1.5 Any supplies to be done under guarantee clause & any other clause of **NIT, GCC, SCC** as relevant to the package.

1.1.6 Packing as per Annexure VI of section I

1.1.7 Forwarding and transportation to delivery address as per SCC.

Note:

a. Any item, not quoted by bidder, but required during refurbishment work of EOT cranes shall be supplied by bidder without any additional cost to purchaser.

**1.2.0 Services to be provided by the bidder**

a) Assessment of existing cranes at site and report submission for approval before starting refurbishment activity.

b) Dismantling of cranes/crane parts at site as per requirement.

c) All activities associated with replacement/renovation/refurbishment of crane equipments as described above in scope of supply.

d) Handling equipment such as mobile crane, hydra crane, fork lift etc. required for dismantling or refurbishment, loading, unloading, assembly and erection of refurbished crane shall be in bidder's scope.

e) Erection and commissioning of crane.

f) Load testing at site.

g) Open store space is available at site. Distance of same from the power house is 3 kms. Unloading, watch and ward shall be in bidder's scope. Refurbishment work can be done in service bay of power house.

h) Packing, forwarding, transportation and handling at site.

i) Handling and disposal of scraps to the area identified by BHEL/Customer at site.

j) Obtaining clearance and acceptance certificate from the concerned competent authority after site test. Necessary fees/expenditure as required shall be borne by the bidder.

k) Training at site during refurbishment work for operation and maintenance.

l) Any certification / license from statutory authority required for installation & putting the crane into service.

m) Boarding and lodging at site for vendor's manpower is available on chargeable basis.

n) Electricity, water facility for Refurbishment of cranes will be provided by Erection subcontractor/ Customer on chargeable basis at single point.

o) Any services to be done under warranty clause & any other clause of NIT, GCC, SCC as relevant to the package.

2.0.0. **Works Excluded**

2.1.0 Refurbishment/ replacement of existing crane structure i.e. bridge girder, operator's cabin, end carriage & rail.

**OTHER REQUIREMENTS:**

**3.0.0. Drawing and documents submission schedule along with number of prints.**

Drawing and documents submission schedule along with number of prints / copies required for various drawing and documents are listed in Annexure –V, section I of this specification.

**4.0.0. Deviations**

If the offer submitted has got any deviation from the technical stipulations in the tender document, bidder shall tabulate the same in the format of "Cost of withdrawal of deviation" attached with GCC and furnishing full particular of such deviations. Deviations are to be furnished with mention to specific clause number (reasons / explanations for such deviations shall be furnished). Notes / comments etc. is not acceptable. If there are no deviations from the tender document, bidder shall mention "NO DEVIATION' in cost of withdrawal of deviation format.

**5.0.0. Makes of Sub - Vendor items**

Makes of bought out items as per Annexure-I, section I of the specification is for reference only. Sub vendor list shall be subject to Customer's approval and same shall not have any impact on manufacturing, delivery schedule and cost of the crane.

**6.0.0** Renovation/replacement of cranes parts are to be inline with IS 3177. Further design, selection of components, material etc. is to conform to IS 3177 in line with details mentioned in tender specification elsewhere.

**7.0.0. Performance Test requirement**

EOT crane along with its drives, controls and other accessories shall be checked for the rated capacity against the rated speed of motions and for the service conditions specified. The bidder shall have the full responsibility for the safe and efficient operation of the crane with associated accessories as a single unit. If the site performance tests indicate the failure of any of the components to achieve the desired performance, the deficiency shall be made good at bidder's cost. Performance test shall be carried out each time after the rectification /modification is carried out. Performance test of the crane shall include load tests and speeds in various motions at site.

**Testing at site**

Completely assembled crane at site shall be check for misalignment of gears, shafts and other items. Following minimum tests shall be conducted on the crane at the site. For load test the heaviest assembly during assembling of TG components/ equipment's shall be used for load testing and the deflection of the bridge shall be as follows.

i. The maximum vertical deflection of the girder produced by the dead load, the weight of the trolley and the rated load shall not exceed 1/600 of the span ( EOT span). In case of non -

availability of rated load, the maximum permissible deflection shall be within limits in proportion to the actual load used. (should be less than or equal to max permissible deflection = span/600 x actual load/ rated load). Existing crane structure shall be cleaned and painted Drawings uploaded. For other details visit site.

ii. Capability of crane to lift the overload from mid-air shall be demonstrated. Electrical tests for brakes, panel, electrical equipment etc. as per IS – 3177.

iii. Speed test at rated load for hoisting, CT and LT mechanism.

iv. Brake test.

v. Any other test as per IS-3177

The test shall be carried out with actual panel, RRC, etc.

**8.0.0 Testing at works for sub assembly and bought out items.**

Quality plans at Section I have been enclosed with this specification to enable the bidder to understand the extent of inspection and testing requirements applicable for all the items which shall be replaced.

# QUALITY ASSURANCE REQUIREMENTS

| | MANUFACTURER/BIDDER/VENDOR NAME & ADDRESS | MANUFACTURING QUALITY PLAN | | | SPEC. NO: PE-TS-470-501-A001 | DATE: 12.07.2022 |
|---|---|---|---|---|---|---|
| | | CUSTOMER: TANGEDCO | | | QP NO.: PE-V0-470-501-A301 | DATE: |
| | | PROJECT: RENOVATION, MODERNISATION & UPRATING OF KODAYAR POWER HOUSE-I FROM 1 x 60 MW TO 1 X 70 MW | | | PO NO.: | DATE: |
| | | ITEM: RENOVATION WORK FOR DOUBLE GIRDER EOT CRANE-135/20T | SYSTEM: EOT CRANES | | SECTION: | SHEET 1 OF 6 |

| SL NO. | COMPONENT & OPERATIONS | CHARACTERIST-ICS | CLASS | TYPE OF CHECK | QUANTUM OF CHECK | | REFERENCE DOCUMENT | ACCEPTANCE NORMS | FORMAT OF RECORD | * | AGENCY | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | M | C/N | | | | D | M | C | N | |
| 1 | 2 | 3 | 4 | 5 | 6 | | 7 | 8 | 9 | | ** | | | 10 |
| **1.0** | **MATERIAL:** | | | | | | | | | | | | | |
| 1.1 | Brake Drums | 1. Chemical & Physical | Major | Chemical & Physical | 100% | - | APPD. DRG. / DATA SHEET | APPD. DRG. / DATA SHEET | TC | √ | P | V | V | |
| | | 2.NDT | Major | U.T ( only boss area ) | 100% | - | ASME Sec.V,article-23,SA-609 | SA - 609 , Level - II | NDT Report | √ | P | V | V | For UT procedure refer Note 4 |
| 2.0 | BOUGHT OUT ITEMS | | | | | | | | | | | | | |
| 2.1 | Wire Rope & slings | Visual & Breaking Strength | Major | Type, grade, breaking strength &visual , Diameter | 100% | - | APPD DRG / DATA SHEET | APPD DRG / DATA SHEET | Mill T.C. | √ | P | V | V | |
| **3.0** | **ELECTRICAL ITEMS** | | | | | | | | | | | | | |
| 3.1 | Transformer (Control transformer, Light transformer etc.) | Make , Rating | Major | Visual | 100% | - | APPD DRG / DATA SHEET | APPD DRG / DATA SHEET | IR | √ | P | V | V | |
| | | Routine Test | Major | Doc. Review | 100% | - | Mfg. Catalogue | Mfg. Standard | TC | √ | P | V | V | |
| 3.2 | SFU , MCCB , MCB , CONTRACTORS , DSL, RELAYS , FUSES , RESISTENCE BOX,HOOTER, DBR, PUSH BUTTONS, indicating instruments , junction box, Limit Switches | Make / Rating / Type / Size | Major | Visual | 100% | - | APPD DRG / DATA SHEET | APPD DRG / DATA SHEET | IR | √ | P | V | V | |
| | | Functional / Continuity Check | Major | Operational | 100% | - | APPD DRG / DATA SHEET | APPD DRG / DATA SHEET | IR / COC | √ | P | V | V | |
| 3.3 | Motor | Type, Rating, Make, Size | Major | Visual | 100% | - | CUSTOMER approved BOI list & ADS / DRG | | Mfg. TC | √ | P | V | V | Refer Note 19 |
| | | Routine Test | Major | Measurement | 100% | | IS: 12615 / App. Data sheet/CUSTOMER ADS | IS: 12615 / App. Data sheet/CUSTOMER ADS | COC / Mfg T.C. (As per Note-3) | √ | P | V | V | |

| BHEL | | | | | |
|---|---|---|---|---|---|
| ENGINEERING | | | QUALITY | | |
| | Sign & Date | Name | | Sign & Date | Name |
| Prepared by: | | | Checked by: | | |
| Reviewed by: | | | Reviewed by: | | |

| BIDDER/ SUPPLIER | |
|---|---|
| Sign & Date | |
| Seal | |

| FOR CUSTOMER REVIEW & APPROVAL | | | |
|---|---|---|---|
| Doc No: | | | |
| | Sign & Date | Name | Seal |
| Reviewed by: | | | |
| Approved by: | | | |

| | MANUFACTURER/BIDDER/VENDOR NAME & ADDRESS | MANUFACTURING QUALITY PLAN | | | SPEC. NO: PE-TS-470-501-A001 | DATE: 12.07.2022 |
|---|---|---|---|---|---|---|
| | | CUSTOMER: TANGEDCO | | | QP NO.: PE-V0-470-501-A301 | DATE: |
| | | PROJECT: RENOVATION, MODERNISATION & UPRATING OF KODAYAR POWER HOUSE-I FROM 1 x 60 MW TO 1 X 70 MW | | | PO NO.: | DATE: |
| | | ITEM: RENOVATION WORK FOR DOUBLE GIRDER EOT CRANE-135/20T | SYSTEM: EOT CRANES | | SECTION: | SHEET 2 OF 6 |

| SL NO. | COMPONENT & OPERATIONS | CHARACTERIST-ICS | CLASS | TYPE OF CHECK | QUANTUM OF CHECK | | REFERENCE DOCUMENT | ACCEPTANCE NORMS | FORMAT OF RECORD | * | AGENCY | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | M | C/N | | | | D | M | C | N | |
| 1 | 2 | 3 | 4 | 5 | 6 | | 7 | 8 | 9 | | ** | | | 10 |
| 3.4 | Brakes | Make, Type ,Rating | Major | Measurement | 100% | - | APPD DRG / DATA SHEET | APPD DRG / DATA SHEET | TC | | P | V | V | |
| | | IR, HV, Functional Test | Major | Measurement | 100% | - | MFG. STD. | MFG. STD. | TC | √ | P | V | V | |
| 3.5 | VVVF Drive | Type, Rating, Make, | Major | Visual | 100% | - | APPD DRG / DATA SHEET | APPD DRG / DATA SHEET | TC/ COC | √ | P | V | V | |
| | | Routine Test | Major | Measurement | 100% | - | APPD DRG / DATA SHEET | APPD DRG / DATA SHEET | TC | √ | P | V | V | |
| 3.6 | Cables ( Power / Control / Trailing / Flexible ) | Make, Type, Size | Major | Visual | 100% | - | APPD DRG / DATA SHEET | APPD DRG / DATA SHEET | TC | √ | P | V | V | |
| | | Routine Test | Major | Measurement | 100% | - | APPD DRG / DATA SHEET | APPD DRG / DATA SHEET | TC | √ | P | V | V | |
| 3.7 | Radio Remote, Master Controller, Pendent Station, Switches | Make / Rating / Type / Functional | Major | Visual | 100% | - | APPD DRG / DATA SHEET | APPD DRG / DATA SHEET | TC / COC | √ | P | V | V | |
| 3.8 | Anti - Collision Device , Cable Gland & lugs , Rectifier ,Lamps, Load cell, Illumination and Earthing material | Make / Type | Major | Visual | 100% | - | APPD DRG / DATA SHEET | APPD DRG / DATA SHEET | TC/ COC | | P | V | V | |
| **4.0** | **OTHER BOUGHT OUR ITEMS** | | | | | | | | | | | | | |
| 4.1 | Bearings | Type & Size | Major | Verification | 100% | - | Appd.drg./ Mfr's catalogue | Appd.drg./ Mfr's catalogue | TC / IR / COC | √ | P | V | V | |
| 4.2 | Tools and tackles | Verification of type size / rating | Major | Verification | 100% | - | As per PO / BBU | APPD DRG / DATA SHEET | TC / COC | √ | P | V | V | |
| 4.3 | Spares (Mandatory / recommended spare / commissioning spares) | Verification of make, type, size , rating | Major | Review Of Internal Inspection Reports / Mfr's TC / COC | 100% | - | Approved Spare List | APPD DRG / DATA SHEET | IR / COC | √ | P | V | V | |
| **5.0** | **IN PROCESS : FABRICATED COMPONENTS : GIRDER, END CARRIAGE, TROLLEY, GEAR BOX CASING , FABRICATED ROPE DRUM** | | | | | | | | | | | | | |
| 5.1 | Fabricated Components (End stopper) | Visual & dimensional | Major | Dimensional & Visual Check | 100% | - | APPD DRG / DATA SHEET | APPD DRG / DATA SHEET | I.R. | √ | P | V | V | At the Time of Final Insp. Of Crane |

| BHEL | | | | | |
|---|---|---|---|---|---|
| ENGINEERING | | | QUALITY | | |
| | Sign & Date | Name | | Sign & Date | Name |
| Prepared by: | | | Checked by: | | |
| Reviewed by: | | | Reviewed by: | | |

| BIDDER/ SUPPLIER | |
|---|---|
| Sign & Date | |
| Seal | |

| FOR CUSTOMER REVIEW & APPROVAL | | | |
|---|---|---|---|
| Doc No: | | | |
| | Sign & Date | Name | Seal |
| Reviewed by: | | | |
| Approved by: | | | |

| | MANUFACTURER/BIDDER/VENDOR NAME & ADDRESS | | MANUFACTURING QUALITY PLAN | | | | | | SPEC. NO: PE-TS-470-501-A001 | | | | | DATE: 12.07.2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | CUSTOMER: TANGEDCO | | | | | | QP NO.: PE-V0-470-501-A301 | | | | | DATE: |
| | | | PROJECT: RENOVATION, MODERNISATION & UPRATING OF KODAYAR POWER HOUSE-I FROM 1 x 60 MW TO 1 X 70 MW | | | | | | PO NO.: | | | | | DATE: |
| | | | ITEM: RENOVATION WORK FOR DOUBLE GIRDER EOT CRANE-135/20T | | | SYSTEM: EOT CRANES | | | SECTION: | | | | | SHEET 3 OF 6 |

| SL NO. | COMPONENT & OPERATIONS | CHARACTERIST-ICS | CLASS | TYPE OF CHECK | QUANTUM OF CHECK | | REFERENCE DOCUMENT | ACCEPTANCE NORMS | FORMAT OF RECORD | * | AGENCY | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | M | C/N | | | | D | M | C | N | |
| 1 | 2 | 3 | 4 | 5 | 6 | | 7 | 8 | 9 | | ** | | | 10 |
| **6.0** | **IN PROCESS INSPECTION OF MACHINED COMPONENTS** | | | | | | | | | | | | | |
| 6.1 | Brake Drums | 1.Visual & dimension | Major | verification | 100% | - | Mfg. Drg | Mfg. Drg | I.R. | √ | P | V | V | |
| | | 2. NDT | Major | DPT after machining | 100% | - | ASME - Sec. V | NO RELEVANT INDICATION | NDT Report | √ | P | V | V | |
| 6.2 | Assembled Gear Box | Mechanical | Major | Backlash ,Contact Pattern | 100% | - | APPD DRG / DATA SHEET /Mfg. Std. | APPD DRG / DATA SHEET /Mfg. Std. | I.R | √ | P | V | V | |
| | | | Major | Reduction Ratio , No Load Run Test For Check of Oil Leakage / Temp. Rise, Vibration & Noise | 100% | 100% | Approved Drawing /Data Sheet/Mfg. Std | Approved Drawing /Data Sheet/Mfg. Std | I.R. | √ | P | V | V | Refer Note 26 |
| 6.3 | DSL Guard | Dimensional | Major | Dimension | 100% | - | Mfg. Drg. | Mfg. Drg. | I.R. | √ | P | V | V | |
| **7.0** | **FINAL INSPECTION** | | | | | | | | | | | | | |
| 7.1 | CONTROL PANEL With VVVF Drive | Identification of all Elect. Components, Cable laying / Dressing/ Feruling /Terminations Dimensional, Functional , HV, IR, interlocks, Protection DOP | Major | Visual, dimensional, Operational & Functional Check , HV,IR, Painting | 100% | 100% | IS:3177 / APPD DRG / DATA SHEET | IS:3177 / APPD DRG / DATA SHEET | I.R | √ | P | W | W | Refer Note 27 |
| | | Paint Shade/ Thk/ Adhesion | Major | Visual / DFT Check | 100% | | APPD DRG / DATA SHEET | APPD DRG / DATA SHEET | TC | √ | P | V | V | Refer Note 28 |
| 7.2 | EOT crane assembly with control panel, Master Controller / Remote Controller Pendent Station (At Site) | Visual & dimensional | Major | Dimensional ,Span, Diagonal & Wheel Base Dimension, LT Stopper Dimension | 100% | 100% | IS 3177 / APPD DRG / DATA SHEET | IS 3177 / APPD DRG / DATA SHEET | I.R. | √ | P | W | W | Refer Note 29 |

| BHEL | | | | | |
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| ENGINEERING | | | QUALITY | | |
| | Sign & Date | Name | | Sign & Date | Name |
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| Reviewed by: | | | Reviewed by: | | |

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| | MANUFACTURER/BIDDER/VENDOR NAME & ADDRESS | MANUFACTURING QUALITY PLAN | | | SPEC. NO: PE-TS-470-501-A001 | DATE: 12.07.2022 |
|---|---|---|---|---|---|---|
| | | CUSTOMER: TANGEDCO | | | QP NO.: PE-V0-470-501-A301 | DATE: |
| | | PROJECT: RENOVATION, MODERNISATION & UPRATING OF KODAYAR POWER HOUSE-I FROM 1 x 60 MW TO 1 X 70 MW | | | PO NO.: | DATE: |
| | | ITEM: RENOVATION WORK FOR DOUBLE GIRDER EOT CRANE-135/20T | SYSTEM: EOT CRANES | | SECTION: | SHEET 4 OF 6 |

| SL NO. | COMPONENT & OPERATIONS | CHARACTERIST-ICS | CLASS | TYPE OF CHECK | QUANTUM OF CHECK | | REFERENCE DOCUMENT | ACCEPTANCE NORMS | FORMAT OF RECORD | | AGENCY | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | M | C/N | | | | * | ** | | | |
| | | | | | | | | | | D | M | C | N | |
| 1 | 2 | 3 | 4 | 5 | 6 | | 7 | 8 | 9 | | | | | 10 |
| | | Operational | Major | (1) Speed & Current Measurement at No Load for Hoist & CT/LT motion (2) Speed & Current measurement at SWL of Hoist & CT & LT motion (3) Over load test for Hoist motion (4) Deflection test (5) Operation Check of Brake at SWL (6) Interlock & Functional test | 100% | 100% | APPD DRG / DATA SHEET / IS 3177 | APPD DRG / DATA SHEET / IS 3177 | I.R. | √ | P | W | W | Refer Note 30 |
| 8.0 | Cleaning & painting | Paint Shade / DFT | Major | Visual , DFT Check | 100% | | APPD DRG / DATA SHEET | APPD DRG / DATA SHEET | IR | √ | P | W | V | |
| 9.0 | Review of QA documentation | | | | | | As per approved QAP | | | V | V | V | V | |
| 10.0 | Packing of components | Packing Soundness | Major | Visual | 100% | 100% | APPD DRG / DATA SHEET /Packing specification | APPD DRG / DATA SHEET /Packing specification | IR | √ | P | W | V | Refer Note 6 |

**NOTES:**

1) Original TCs / Photocopies certified in original by mill shall be furnished for review. Test In absence of correlated TCs Check test shall be carried out from each plate/ bar for above 10 mm thk., certificates shall be offered for review at the time of stage inspection of components / assembly. Supplier shall ensure that pitted material is not used.
2) Blank
3) Performance of electrical & control devices along with the interlocks, protection & sequence to be checked after crane assembly at works.
4) Blank.
5) Following to be noted for packing:
   a) Packing shall be suitable for storage at site in tropical climate conditions.
   b) Blank.

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| Approved by: | | | |

| | MANUFACTURER/BIDDER/VENDOR NAME & ADDRESS | | MANUFACTURING QUALITY PLAN | | | | | SPEC. NO: PE-TS-470-501-A001 | | | | DATE: 12.07.2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | CUSTOMER: TANGEDCO | | | | | QP NO.: PE-V0-470-501-A301 | | | | DATE: |
| | | | PROJECT: RENOVATION, MODERNISATION & UPRATING OF KODAYAR POWER HOUSE-I FROM 1 x 60 MW TO 1 X 70 MW | | | | | PO NO.: | | | | DATE: |
| | | | ITEM: RENOVATION WORK FOR DOUBLE GIRDER EOT CRANE-135/20T | | | SYSTEM: EOT CRANES | | SECTION: | | | | SHEET 5 OF 6 |

| SL NO. | COMPONENT & OPERATIONS | CHARACTERIST-ICS | CLASS | TYPE OF CHECK | QUANTUM OF CHECK | | REFERENCE DOCUMENT | ACCEPTANCE NORMS | FORMAT OF RECORD | | AGENCY | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | M | C/N | | | | D | M | C | N | |
| 1 | 2 | 3 | 4 | 5 | 6 | | 7 | 8 | 9 | * | ** | | | 10 |

c) Photographs of items duly placed inside the box just before the final packing and photographs of the box just before dispatch to be sent to BHEL purchase group for review before issuing MDCC.

6) In case of foreign supplier, all test certificates shall be furnished by the supplier, duly witnessed/verified by supplier's TPI.
7) The latest revisions/year of issue of all the standard indicated in the QP shall be referred.
8) Blank.
9) Blank.
10) The heat no. /plate identification no. shall be transferred on all major cut pieces of the MS plate for proper correlation, cutting plan of each plate shall be maintained for proper traceability.
11) Welder no. shall be punched near butt weld joints, the welding plan of each fabricated item shall be maintained.
12) In absence of co-related TC, check testing shall be witnessed on samples selected by Main contractor.
13) Co-related Mill TC inclusive of UT will be reviewed by BHEL/CUSTOMER, In absence of UT conformance in Mill TC, then UT will be witnessed by BHEL. For UT procedure refer Note 4.
14) Mech. Properties against H.T condition if applicable against respective Material standard/Grade. Hardness test report review after applicable Q & T condition.
15) Blank
16) Blank.
17) Blank.
18) Blank.
19) For Motors of 50kW rating & below routine tests to be witnessed by supplier and type test Certificate for identical frame size will be reviewed for validity and conformance. Photocopies of Type Test Certificates are acceptable but shall be authenticated by Manufacturer.
20) Identification by BHEL/Customer
21) Blank
22) Welder/procedure qualification will be witnessed by Customer/ BHEL as per appd. WPS. In case the BHEL/NTPC/Lloyds /any other renowned approving agency already available, and doing the job, requalification is not required.
23) Blank.
24) Blank
25) BlankR.
26) Noise Max.85 db at 1 mtr. & $30^0$ C temp. rise at ambient. Witness for Noise & vibration measurement during the final inspection
27) HV at 2.5 KV AC for power ckt at 2 KV for control ckt, DOP by paper insertion method. BOI as per CUSTOMER Approved Makes. Will be Checked at the time of Final Inspection.
28) 7 Tank Pretreatment before Painting.
29) Crane Should be Operable by RRC & PPB (Radio Remote Controller, Pendent) meant for that Crane only.
30) Functional & Interlock test to be checked as per approved Electrical Schematic drawing.

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| | MANUFACTURER/BIDDER/VENDOR NAME & ADDRESS | | MANUFACTURING QUALITY PLAN | | | | | SPEC. NO: PE-TS-470-501-A001 | | | DATE: 12.07.2022 |
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| | | | CUSTOMER: TANGEDCO | | | | | QP NO.: PE-V0-470-501-A301 | | | DATE: |
| | | | PROJECT: RENOVATION, MODERNISATION & UPRATING OF KODAYAR POWER HOUSE-I FROM 1 x 60 MW TO 1 X 70 MW | | | | | PO NO.: | | | DATE: |
| | | | ITEM: RENOVATION WORK FOR DOUBLE GIRDER EOT CRANE-135/20T | | | SYSTEM: EOT CRANES | | SECTION: | | | SHEET 6 OF 6 |

| SL NO. | COMPONENT & OPERATIONS | CHARACTERIST-ICS | CLASS | TYPE OF CHECK | QUANTUM OF CHECK | | REFERENCE DOCUMENT | ACCEPTANCE NORMS | FORMAT OF RECORD | * | AGENCY | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | M | C/N | | | | D | M | C | N | |
| 1 | 2 | 3 | 4 | 5 | 6 | | 7 | 8 | 9 | | ** | | | 10 |

**LEGENDS:**

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,

** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **C**: BHEL/ THIRD PARTY INSPECTION AGENCY, **N**: TANGEDCO,

**P**: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE

**MA**: MAJOR, **MI**: MINOR, **CR:** CRITICAL. **H** - Hold point

| BHEL | | | | | |
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| ENGINEERING | | | QUALITY | | |
| | Sign & Date | Name | | Sign & Date | Name |
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| Reviewed by: | | | Reviewed by: | | |

| BIDDER/ SUPPLIER | |
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| Approved by: | | | |

# SECTION I
# CUSTOMER SPECIFICATION

## 06. LIST OF PREFERED MAKES

TRANSFORMERS

| | |
|---|---|
| GENERATOR TRANSFORMER | CGL/BHEL /KEC / TR / EMCO / ALSTOM |
| LT Transformer | BHEL/CGL/GEC ALSTHOM/ VOLTAMP/EMCO |
| 110 kV ISOLATOR | S&S, ELPRO INTERNATIONAL, HIVELM, GR POWER, Hyderabad |
| 110kV CURRENT TRANSFORMER | AE / ABB / AREVA / CGLI / GEC |
| 110kV POTENTIAL TRANSFORMER | AE / ABB / AREVA / CGLI / GEC |
| 110 kV LIGHTNING ARRESTOR | ELPRO INTERNATIONAL LIMITED / W.S INDUSTRIES LTD / OBLUM INDUSTRIES LTD |
| HV BUSDUCT | ECC (KOLKATA)/ STAR DRIVE NOW KGS ENGINEERING LIMITED(CHENNAI)/ ENPRO (CHENNAI)/ BEST & CROMPTON/ SIEMENS/ BHEL/ CONTROL & SWITCHGEAR |
| 11kV /LT CURRENT TRANSFORMER | AE /ABB/ JYOTI / KAPPA / WSI/INDCOIL |
| 11kV POTENTIAL TRANSFORMER | AE /ABB/ JYOTI / KAPPA / WSI / INDCOIL |
| 415V SWITCHGEAR | LARSEN &TOUBRO LTD (ECC GROUP) / SIEMENS LTD / ASIA BROWN BOVERI LTD /GEC (ALSTHOM) |
| MOTOR CONTROL CENTRES | SIEMENS LTD / ASIA BROWN BOVERI LTD /KIRLOSKAR ELECTRIC COMPANY LTD / GEC ALSTHOM INDIA LTD |
| LT AIR CIRCUIT BREAKER, | SIEMENS/ BCH/GE(ALSTHOM)/ L&T/ C&S/ SCHNEIDER |
| UPS | SIIEMENS / HIREL / EMERSON/GE / DB POWER CONTROL |

| | |
|---|---|
| SOLID STATE ANNUNCIATOR | APLAB/ L&T/ ELECMECH/PROCON/ MINILEC/ CONTROL-AND DYNAMICS |
| NUMERICAL PROTECTION RELAYS | SIEMENS/ ABB/ AREVA FOR LT SYSTE SCHNEIDER/ L&T(MM30)/ ASIDA |
| NUMERICAL PROTECTION RELAYS | AREVA / SIEMENS / ABB / L&T FOR HT SYSTEM |
| AUXILIARY RELAYS | AREVA/ EASUN/ ABB/ L&T/ GE/ SCHNEIDER/ SIEMENS/ BCH/ ROCKWELL |
| AMMETER/ VOLTMETER | AEP/ IMP/ MECO AE/GEC// L&T WATTMETER/ VAR-METER |
| VOLTAGE/ POWER/ CURRENT TRANSDUCER | /ABB/AEP/ EMENS/FREQUENCY/ENERGY ELSTER / ADEPT |
| MOULDED CASE CKT BREAKER | SIEMENS/ GE POWER/ L&T/ABB/ SCHNEIDER/ BCH/ ANDE-RW YULE |
| INDICATING LAMP LED TYPE) BINAY/ J-AUER | SIEMENS/ VAISHNO/ TECHNIK/LUSTER |
| HOOTER/ BUZZER/ BELL | GETCO/ KHERAJ/ EDISON/KAKKU |
| HT CABLES | RPG/ CABLE CORPORATION OF INDIA LTD/ FORT GLOSTER INDUSTRIES (T) HOWRAH / ASIAN CABLES & INDUSTRIES LTD |
| LT CABLES | RPG/ CABLE CORPORATION OF INDIA LTD/ FORT GLOSTER INDUSTRIES (T) HOWRAH / ASIAN CABLES & INDUSTRIES LTD |
| CONTROL CABLE | RPG/ CABLE CORPORATION OF INDIA LTD/ FORT GLOSTER INDUSTRIES (T) HOWRAH / ASIAN CABLES & INDUSTRIES LTD |
| LOCAL PUSH BUTTON STATIONS | SIEMENS/ L&T/ BCH/ BHEL/ C&S/ TECHNOCRAT/ B&C/ MEDITRON/ ELECTRO FABRIC/ HCE/ SEN & SINGH |

| | |
|---|---|
| | /TECHNO COMMERCE/ SWITCHING CIRCUIT/ VIJAY SWITCHGEAR |
| LIGHTING FITTINGS | PHILIPS/GE/ BAJAJ/(SV/MV/MH/FLUROESCENT/CFL) CGL/ WIPRO/ FLOROCRAFT |
| HT CABLE JOINTING KITS & TERMINATION KITS | RAYCHEM/ 3M/ DENSONS// M – SEAL |
| CONTACTORS | SIEMENS / ALSTHOM / L&T / CGL / SCHINDIR/BCH/ABB |
| HT HRC FUSES<br>TEMPERATURE SCANNER | AREVA/ DP/ S&S/ COPPER- BUSSMAN<br>JYOTI / APLAB/SYNTECH / MASIBUS |
| MCCB | SCHNEIDER (MG)/ L&T/ ABB/SIEMENS/ GE POWER CONTROL / CONTROL & SWITCHGEAR/ BCH /MDS( LEGRAND |
| MINIATURE CIRCUIT BREAKER | SIEMENS/ L&T/ GE POWER CONTROL/SCHNEIDER (PROTEC / MG)/ STANDARD/INDOASIAN/ HAVELLS/ MDS (LEGRAND)/ ABB |
| MOTORS | SIEMENS LTD / ASIA BROWN BOVERI LTD/ / KIRLOSKAR ELECTRIC COMPANY LTD / GEC ALSTHOM INDIA LTD |
| TERMINAL BLOCK | EPCC/ ELMEX/ PHOENIX CONTACT/ CONNECT WELL/ ESSEN DEINKI/ WAGO/LAPP/ S&S/ HANSEL |
| MIMIC PANELS & ANNUNCIATION PANELS | L&T / ADVANI OERLIKON / GE POWER CONTROL/ BHEL/ BCH/ TRANSRECT/ MINLEC/ TIRUPATI ELECTRONICS/ ADVANCE POWER CONTOL/ CONTROL DEVICES |
| ACSR CONDUCTOR | APAR, MUMBAI, SMITA CONDUCTORS, DEEPAK CABLES, GUPTA CONDUCTORS, ALIND CORPORATION |

07. **LIST OF SPECIFICATION DRAWINGS**

For specification drawings refer Volume IV.

**RENOVATION, MODERNISATION AND UPRATING OF**

**KODAYAR POWER HOUSE - I**

**FROM 1 X 60MW TO 1 X 70 MW**

**IN TIRUNELVELI GENERATION CIRCLE**

**KANYAKUMARI DISTRICT, TAMILNADU, INDIA**

**INTERNATIONAL COMPETITIVE BIDDING**

**TENDER SPECIFICATION NO. HE – 2367**

# VOLUME II OF IV

# TECHNICAL SPECIFICATION-
# MECHANICAL & CIVIL

OFFICE OF THE
SUPERINTENDING ENGINEER
HYDRO (ELECTRICAL)
5th FLOOR, EASTERN WING
NPKRR MAALIGAI,
144, ANNA SALAI, CHENNAI - 600 002.

## INDEX TO VOLUMES

# CONTENTS

## VOLUME-II

## 01. PREAMBLE

i. This specification shall be read in conjunction with the general conditions, other technical details as provided in Vol. I, II, III and the drawings in Vol-IV. This volume deals with the specification for Mechanical & Civil works including Dismantling of TG and all equipment, Renovation of embedded parts, Supply of Turbine, Governing system, Generator, Excitation System, Mechanical Auxiliaries and Civil works on Turnkey Installation for Renovation, Modernisation & Uprating with new Turbine-Generator from 1x60MW to 1x70MW of Kodayar Power House-I, Kodayar in Kanyakumari District of Tamilnadu.

ii. Electrics and Control & Instrumentation (C&I) including Generator CT, PT, LA, NGTR, Generator Transformer, Auxiliary transformers, switchyard equipment and C&I, etc., are covered under Vol. III of the Tender Specification.

## 02. INTENT OF SPECIFICATION

a) This specification is intended to familiarise the tenderer with the scope of work & services and technical requirements of the subject work. The Tenderer shall study the specification and satisfy himself regarding the workability of the proposed system and shall take full responsibility for the design and engineering of the system & equipment, quality of material, workmanship, guaranteed operation and smooth performance of the system & equipment.

b) If the tenderer wishes to deviate from this specification, the same shall be clearly brought out with justification in the format provided. However, reduction / change in scope will not be entertained.

## 03. SPECIAL INSTRUCTIONS TO TENDERERS

a) This technical specification (TS) is intended to provide general guidance to the tenderer. All such items, even though not specifically mentioned in this TS, but considered necessary for safe & satisfactory operation and guaranteed performance of the offered system & equipment, shall be considered included in the offer.

b) The tenderer shall visit and carefully examine the site and surroundings to satisfy himself about the nature and condition of all existing facilities, general site condition etc. and all other matters affecting the works. Claim and objection due to ignorance of site condition shall not be considered after submission of offer.

c) All equipment, system and works covered under this specification shall comply with all latest statutes, regulations and safety codes as applicable at Kodayar, Kanyakumari District, Tamilnadu, India. All systems and equipment shall comply in all respects with the requirements of the latest editions of the related IS, IEC, IEEE, VDE, DIN, JIS or any other approved international codes and standards. The electrical equipment shall also conform to the latest Indian Electricity rules, Electricity Act as well as Tamilnadu State Government rules.

d) Other standards are acceptable if they are established to be approved equal or superior to the listed standards subject to approval by the TANGEDCO/Purchaser. The tenderers shall provide English version of the codes and standards applicable.

e) Proposals not meeting the above stipulations of the codes and standards may not be acceptable.

f) The successful tenderer shall study the quality of water at site for suitable design of submerged components of the turbine and material shall be so selected that cavitation and corrosion are minimised.

g) Special instructions indicated in Vol III are complimentary to the above mentioned instructions and tenderer to consider all instructions as a whole.

## 04. GENERAL TECHNICAL RULES

### 04.01 INTRODUCTION

a) This part of the specification describes the general technical rules to be followed while carrying out the work of Renovation, Modernisation & Uprating with new Turbine-Generator from 1x60MW to 1x70 MW of Kodayar Power House-I, Kodayar in Kanyakumari District of Tamilnadu. The technical requirements for electrical and Control & instrumentation work are described in volume III of the Tender Specification.

b) The purpose of this `General Technical Rules' is to provide the Tenderer with certain general information on the location and conditions existing at site and to lay down common guidelines and specifications which the Tenderer shall follow in designing the plant and execution of work. Adherence to the `General Technical Rules' shall, however, not relieve the Tenderer of his responsibility regarding type, quality of materials, workmanship and requirement as specified by the TANGEDCO/Purchaser under `Technical Specifications' `Invitation to Tender' and `Draft Contract'.

c) The Tenderer shall satisfy himself regarding the site conditions and other relevant matters by visiting site. It is desirable, for compelling reasons, to deviate from these instructions; he is required to obtain prior approval from the TANGEDCO/Purchaser.

d) All equipment to be supplied and/or engineering services and technical services to be rendered shall be manufactured/executed in accordance with the best trade/ engineering practices judged by the established standards and as given in the Technical Specification. Wherever the codes are not mentioned the best international standards to be approved by the TANGEDCO/Purchaser shall be followed.

e) Any supplies and services which might have not been specifically mentioned in the Technical Specification, but are necessary for efficient and smooth operation and maintenance of the work under Indian conditions, unless expressly excluded from the scope of supplies and services shall be supplied/ provided by the successful Tenderer without any extra cost to the TANGEDCO/Purchaser.

## 04.02 PLANT AND EQUIPMENT

### 04.02.01 GENERAL

a) The selection, design and manufacture/fabrication of plant and equipment shall be suitable for the intended service and duty conditions and ensure maximum interchangeability of components and least maintenance. The unit shall be complete in all respect.

b) All the equipment, technological structures, pipes, valves, fittings, etc shall be subjected to inspection and testing as per accepted national or international standards and practices. All the components shall be subjected to inspection and testing as per standard practices of the manufacturer prior to offering them for inspection by the Purchaser /his authorised representative.

c) All equipment shall be complete with approved safety devices, wherever a potential hazard to personnel and or equipment exists. There shall be adequate provision for safe access of personnel to and around the equipment for operational and maintenance functions.

d) All equipment shall be complete in all respect including all accessories essential for proper installation, operation and maintenance irrespective of whether such items are specifically mentioned in the specifications or not.

e) All working parts shall be arranged for convenience of operation, inspection, lubrication and ease of repair and replacement of parts and sub- assemblies with minimum downtime.

f) Suitable working platforms, walkways, ladders lifting tackles and tools required for the above shall be provided.

g) The fabrication and assembly areas shall be kept clean and free from contamination. During assembly of major components, a polythene covering shall be maintained in position to prevent ingress of dirt, grease, etc from overhead cranes or other equipment.

h) During fabrication, equipment, pipes, etc shall be kept sealed to the extent possible to avoid entry of foreign matter and contamination by dirt.

i) Piping shall be degreased after fabrication and maintained sealed until the end is presented for welding or jointing.

j) All equipment shall be visually inspected in the presence of an inspector immediately before closure. A system of physical identification and accountability shall be used to account for all tools, test equipment, shipping blanks and other items used during assembly to obviate the possibility of their being left inside vessels or equipment.

k) On completion of manufacture, each pressure vessel shall be pressure tested at room

temperature in accordance with the appropriate code. The test fluid used for pneumatic test shall be dry and oil free compressed air. Leaks shall be detected by use of water solution of inhibited detergent.

l) On completion of construction, the entire assembly shall be leak tested as above. The detergent shall be washed off with clean water on completion of test before insulation work.

## 04.02.02 DESIGN CONSIDERATIONS

a) Life of the Electro-mechanical generating equipment i.e., turbine, generator, transformers, auxiliaries etc. shall not be less than thirty five (35) years.

b) The Unit shall be designed for unconstrained operation over maximum net head and minimum net head and full range of ambient and other environmental conditions. The turbine centre line level shall be as available and indicated in Ch-6. Speed rise, pressure rise, run away speed shall be governed by the limits specified in relevant IS.

c) Chemical analysis of water and data including the petro graphic analysis shall be taken into consideration while designing the turbine and other auxiliary equipment susceptible to abrasive effects of silt. Suitable materials, protective coatings and painting shall be provided to resist silt abrasion as per site conditions.

d) The operation of the each Unit shall be smooth and quiet. The noise level shall not be more than 90 dBA at a distance of 1metre from any equipment.

## 04.02.03 LAYOUT CONSIDERATIONS

a) Layout of equipment shall be developed considering the proper utilisation of space, functional requirements, and future extensions. The equipment layout shall be compact so as to economise use of materials.

b) Maintenance facilities shall be provided as required for assembly, disassembly and handling during maintenance of all equipment and auxiliaries.

## 04.02.04 OPERATING CAPABILITY OF THE GENERATING UNIT

a. The Unit shall be capable of giving the rated output continuously as specified by the manufacturer at the rated design head and rated discharge and shall be capable of operating between the minimum and maximum head specified in this specification (Vol-II) and ambient temperature at site specified.

b. The maximum continuous over load capacity of the units at the generator terminals during the high head conditions or high discharge conditions or both as guaranteed by the manufacturer shall be based on the hydraulic parameter of the station.

c. The Units and associated auxiliaries shall be suitable for continuous operation without any restriction within a frequency range of -5% to +3% (47.5Hz to 51.5 Hz). All the equipment driven by the electric motors shall give their rated performance even at a power supply frequency of 47.5 Hz.

d. Provision shall be made for starting the Unit in auto mode up to synchronisation by a single command and loading of the unit to full load quickly. The design of the equipment and control system shall permit participation of the units in auto frequency control mode.

e. The Unit and all its associated auxiliaries shall be designed for trouble free operation up to maximum rating of the units for complete range of operation for active power and reactive power output.

f. The redundancy in the Units auxiliaries and station equipment shall be provided so that the generating unit continues to operate even in the event of outage of a part of the auxiliary system.

## 04.03 MANUFACTURING AND FABRICATION

### 04.03.01 GENERAL

a) All forgings, castings and structural materials shall conform to the relevant BIS/ International standards.

b) Special non-ferrous materials required for manufacturing parts subject to heavy pressure, severe working conditions, and/or requiring high tensile strength, toughness and resistance to corrosion shall be used.

c) Bronze used for manufacturing parts such as bearings, shall preferably be forged or centrifugally cast.

### 04.03.02 WORKING STRESSES

a. For rotating parts the units stresses due to run away speed of turbine shall not exceed two third of the yield strength of the material of construction.

b. For other material used in the manufacture of the generator and exciter, etc, the maximum stresses due to the most severe operating condition shall not exceed one third of the yield point nor one fifth of the ultimate strength of the materials. For temporary over loads, units stress not exceeding one half of the yield point stress will be permitted.

**04.03.03 BEARINGS**

All parts subject to reciprocal motion and rubbing against other parts, shall be provided with bronze or other suitable liners to minimise wear. The liners shall conform to IS:318 or as detailed against the particular equipment capable of being adjusted to compensate for wear. All rotating parts supported on frames shall have proper bearings depending upon speed, torque, load condition, etc.

**04.03.04 MACHINE FRAMES AND BASES**

a) All machines bases shall be designed for maximum strength and rigidity consistent with good design.

b) Base plates shall be of welded steel construction. Those shall be designed with sufficient depth and stiffness to ensure rigidity of assembly.

c) If bases are made of two or more parts to make up height, locating pins shall be provided. Machined bolts shall be used in drilled and reamed holes for connecting the parts.

d) The machine frames shall have suitable eye bolts or hooks in requisite numbers for lifting purposes during erection and maintenance.

**04.03.05 NUTS, BOLTS, STUDS AND WASHERS**

a. Machining and manufacturing of all the nuts, bolts, studs and washers shall conform to International Standards.

b. Nuts and bolts for pressure parts shall be of the best quality steel.

c. Nuts, bolts and studs shall be of materials most suitable for the service operating conditions and designed to ensure the stresses arising in normal operation. For bolts used in critical areas the contractor shall provide the following details :

   i) Allowable elongation
   ii) Recommended torque

d. Fitted bolts shall be a close fit in the reamed holes they occupy, and shall be marked in a conspicuous position to ensure correct assembly.

e. The threaded portion of any bolt or stud shall not project more than 1.5 threads above the surface of its mating nut.

f. Where practicable the use of slotted head screws shall be avoided in machinery component assemblies, hexagon socketed screws being preferred.

**04.03.06 STEEL FORGING**

a) The successful Tenderer shall supply a list of all important forgings and draw up material specification for each one. Copies of this list and specifications shall be supplied to the Purchaser for his use. In each case the quality and inspection requirements shall be clearly stated.

b) Whenever possible steel forgings shall be in accordance with the requirements of International Standards. Forgings shall be free from cracks externally or internally, extensive non-metallic inclusions and surface defects. The successful Tenderer shall carry out non- destructive testing of forgings during machining to verify that no unacceptable defects are present.

c) Repairs by welding or other means shall not be undertaken on forgings at any stage of the production cycle.

d) Each forging shall be suitably branded with an identification number which shall be transferred throughout all final machining stages. The identification number shall be marked on all documents and test certificates relative to the forging.

**04.03.07 CASTINGS**

**04.03.07.01 GENERAL**

All castings shall be homogeneous, free of shrinkage, under sizing, porosity or voids. Welding, filling, interlocking or plugging of defective parts shall be done with the approval of Purchaser in writing. All repairs shall be subjected to non- destructive examination after heat treatment.

**04.03.07.02 STEEL CASTINGS**

a. The successful Tenderer shall prepare material purchasing specifications for all important castings. Each document shall indicate fully the quality and inspection requirements for the component casting covered. Copies of the Specification shall be issued to Purchaser for his use.

b. Castings may be repaired by welding provided written approval of the Purchaser is obtained in advance. The successful Tenderer shall submit drawings, sketches or photographs showing the location and principal dimensions of the defects together with the proposed weld repair procedure.

c. Only welders who have passed an appropriate qualification test shall be employed on the repair of castings. All repairs shall be carried out by the metal arc process.

d. Ultrasonic inspection shall be applied to all important castings to locate the extent of sub-surface defects and to check the wall thickness.

e. All castings shall be identified by stamped, or cast-on reference marks which shall be entered on all relevant documents and test certificates.

f. The Purchaser may require that certain castings shall be examined using radiographic inspection.

**04.03.07.03 CAST IRON CASTINGS**

Cast iron shall not be used for any part of equipment which is in tension or which is subjected to impact.

**04.03.07.04 ALUMINIUM BRONZE CASTINGS**

The successful Tenderer shall prepare material purchasing specifications for all important aluminium bronze castings. Each document shall indicate fully the quality and inspection requirements for the component casting covered. Copies of the Specification shall be issued to the Purchaser for his use. The inspection and quality requirements shall include an analysis of each cast, mechanical testing of test bars from each cast, pressure testing, penetrant flaw detection and radiographic examination of selected critical areas.

**04.03.08 HYDRAULIC SYSTEM**

a) Hydraulic systems required for various units referred herein generally cover the following:
b) Hydraulic fluid reservoir, pumps of various kinds, valves, accumulators, Hydraulic cylinders, oil coolers, Hydraulic motors, various accessories such as filter, strainers, hydraulic pipe work, fittings, flexible hose supporter for equipment, sealing devices, instruments for indicating, recording and integration of various parameters such as pressure, temperature, velocity etc., control devices for manual and automatic operation of the system, safety devices and alarms for abnormal operating condition, interlocks for sequencing and safe operation.

c) Hydraulic fluids shall be used on the basis of proven performance, operating condition, operating costs and easy availability.

d) The Hydraulic power system shall be suitable in every way for the service intended and shall be oriented forwards maximum interchangeability of component and minimising maintenance.

e) Hydraulic systems shall have filters at various points with adequate capacity and necessary filtration rating so as to keep the hydraulic fluid within permissible limits of contamination to achieve maximum life of the components.

f) Each hydraulic circuit shall be designed to minimise surge pressures, etc.

g) The hydraulic system shall be designed taking into account the maximum pressure encountered. Also one must ensure while designing the system that the components of

hydraulic systems are compatible with the hydraulic fluid selected at operating condition in the plant and under atmospheric conditions prevalent at Kodayar Power House-I. The hydraulic units shall be of standard make.

**04.03.09 LUBRICATION**

a) The successful Tenderer shall provide for proper lubrication systems for all moving parts of the equipment supplied.

b) All oil lubrication systems shall preferably be of circulating type complete with oil reservoir, pumps with motors, filter pressure vessels, pressure regulators, heat exchangers, oil heater, temperature controllers etc., flow switches, level switches, pressure gauges, pressure switches, temperature gauges, oil flow indicators, etc. The oil tanks shall have adequate capacity so as the return oil de aerates, gives away heat picked up from lubricating points before again being pumped.

c) Wherever there is chance of water ingress into the oil lubrication system, the provision for water detection/removal shall be provided.

d) The selection/design and construction shall be suitable in every way for the service intended and shall be oriented towards maximising interchange- ability of components and minimising maintenance.

**04.03.10 OPTIMISATION OF INDIAN SUPPLIES & SERVICES**

The successful Tenderer shall make all efforts to optimise the supplies and services from Indian sources and shall, however, ensure that the performance of the plant and equipment are achieved as envisaged in the Technical Specification.

~~**04.03.11 PUMPS**~~

~~Centrifugal pumps shall be provided unless technical or strong economic reasons dictate that a positive displacement, either rotary or reciprocating is more appropriate.~~

~~**04.03.12 VALVES**~~

~~**04.03.12.01 GENERAL**~~

~~a) All valves shall be suitable for the service conditions under which they are required to operate. The design, construction and choice of material shall take into account all operational requirements.~~

~~b) A complete valve schedule for each pipe work system shall be provided during the contract engineering, in accordance with the specified format.~~

~~c) Parallel slide, butterfly or gate valves may be used for air, water services, and sluice valves for low head applications.~~

**04.03.13.03 INTERNAL CLEANING OF PIPES**

I. The successful Tenderer is responsible for ensuring that the internal surface of all pipelines is thoroughly clean before the pipelines are placed in commission.

II. The procedure adopted is to include the following:

a) Thorough cleaning of all internal surfaces prior to erection to remove accumulations of dirt, rust, scale, and welding slag due to site welding before erection.

b) Prior to, and during erection, all parts shall be inspected to make sure that they are clean and adequate steps shall be taken to prevent entry of foreign matter both during and after erection. Each section erected shall be cleaned out before being connected into the previous section. All headers shall be cleaned before closing up.

c) Thorough cleaning of all pipe work after erection by flushing with water.

d) Already embedded pipes shall be cleaned with wire brush/ pickling to bring back original / required ID.

III. The successful Tenderer shall provide all necessary facilities in the pipe system for carrying out the requirements of item (b) including and temporary pipe work, valves and supports.

**04.03.14 TRAPS, DRAINS AND VENTS**

The successful Tenderer shall provide all traps, drains and vents which are called for in this Specification or which are necessary for plant operation, line or plant filling.

Drains and vents from different systems, or parts of systems operating at widely differing pressures, shall not be interconnected. At highest point vent and lowest point drain should be provided to avoid the water hammering.

**04.03.15 WELDING GENERAL REQUIREMENTS**

**04.03.15.01 GENERAL**

All welding shall conform to the relevant National or International Standard Specification as agreed by the Purchaser.

**04.03.15.02 WELDING EQUIPMENT**

Any welding equipment which in the opinion of the Purchaser, unsuitable or unsatisfactory for the service for which it is being used, shall be replaced by the Contractor.

The absence of comment by the Purchaser shall not be taken as approval for any equipment.

**04.03.15.03 WELD PROCEDURE DOCUMENTS**

Complete and full detailed weld procedure documents shall be kept and these shall be made available to the Purchaser on request.

Prior to the commencement of the welding the Contractor shall submit to the Purchaser for approval the welding procedures to be used in the fabrication of the relevant sections of work.

**04.03.15.04 WELDERS QUALIFICATION TESTS**

All welders shall be qualified for the work and shall hold current welder's qualification certificates in accordance with National Standards.

Records showing the date and result of the qualification tests performed by each welder and weld operator together with the identification number assigned to him shall at all times be available for scrutiny by the Purchaser.

**04.03.16 WELDING INSPECTION**

**04.03.16.01 QUALITY REQUIREMENTS FOR WELDS**

All welds subjected to non-destructive tests shall be entirely free from cracks or crack like defects, lack of root fusion, lack of sidewall fusion, root burn through or tailed pores. The standard for porosity and slag inclusions will be as indicated in the agreed standards for design and welding.

**04.03.16.02 VISUAL WELD INSPECTION**

Each weld shall be subjected to a stringent visual inspection and shall be free from undercut, cracks, porosity and other surface imperfections.

Fillet welds shall be checked for dimensional tolerance and from using a fillet weld gauge. Fillet welds should be slightly concave in form and each leg of the weld shall have equal length.

**04.03.16.03 NON-DESTRUCTIVE EXAMINATION**

All non-destructive examinations shall be supervised by a fully qualified and experienced specialist appointed by the successful Tenderer . Individual operators in each of the respective techniques shall be qualified and trained in the respective subject.
Dye Penetrant test, Ultra sonic examination, Radiography, Magnetic crack detection shall be carried out in accordance with National Standards.

**04.03.16.04 WELD REPAIRS**

The Purchaser's approval shall be obtained prior to commencement of any repair or rectification work.

Weld repairs shall be made to the same procedure as for the original weld. All tests shall be repeated after the repair has been completed.

**04.03.16.05 MANDATORY INSPECTIONS**

All transmission welds between dissimilar materials, such as high alloy steel to carbon steel, or non-ferrous materials to steels, shall be subjected to 100% ultrasonic examination or crack detection wherever practicable. In addition, all butt welds between dissimilar materials shall be subjected to 100% radiographic examination.

All welds in ferritic alloy steels, e.g., having a carbon equivalent value in excess of 0.40%, and high yield-strength steels, e.g. having yield strength greater than 300 MPa, shall be subjected to 100% ultrasonic examination and crack detection wherever possible. In addition, all butt welds in these materials shall be subjected to 100% radiographic examination.

## 04.04 NOISE AND VIBRATION

### 04.04.01 NOISE

Maximum noise level tolerable in work areas shall be within the applicable limit. The equipment and the services shall be designed such that limits are not exceeded. The Tenderer shall indicate the maximum noise level guaranteed for each equipment/system with detailed description of noise control measures adopted, if any.

### 04.04.02 VIBRATION AND BALANCE

The Plant shall be designed and constructed to operate without vibration in so far as the nature of the works will permit. Where vibration must be expected this shall be reduced to the minimum which can be achieved by good design and careful balancing in the case of rotating plant.

The amplitude of vibration of rotating plant when measured on the bearing housings under steady state conditions at the designed operating speeds shall conform to IEC 34-14(1982) or equivalent International Codes.

### 04.04.03 SCAFFOLDING, STAIRWAY AND LADDERS

Where safe and easy plant operation and maintenance cannot be arranged from provided floor levels, the Contractor shall supply and erect all platform galleries, stairways, access

ways and ladders necessary for providing the required safe and easy access to the plant items. The Contractor shall ensure that the whole of the access ways are of uniform design and pattern throughout the Works. Where access is required for operation then standard design stairways must be provided, but if infrequent access for maintenance only is required then vertical ladders will be considered.

**04.04.04 SAFETY GUARDS**

All moving parts, shafts, couplings, flywheels, bare conductors and hot or cold surfaces shall be adequately and securely guarded in accordance with the prescribed legislation and to the Engineer's approval so as to afford complete safety to all personnel.

**04.05 SPECIAL TOOLS AND TACKLES**

Special tools and tackles shall be supplied under this Contract for use by the Purchaser. List of tools and tackles shall be provided by tenderer.
Each tool or appliance is to be clearly marked with its size and/or purpose.
The tools and appliances supplied shall not be used for erection purposes by the successful Tenderer and shall be handed over in new condition.

**04.06 PAINTING**

**04.06.01 GENERAL**

a) The primers & finishing paints will conform to latest Indian Standard or equivalent international standards. There shall be of approved quality and shade.

b) General precautions for painting such as preparation of surfaces, application of paints, inspection and testing etc. will be as per relevant clause of IS:1477 (Part I & II) and shall be followed, wherever possible.

c) General compatibility between primer and finishing paints recommended by the paint manufacturer, supplying these paints shall be followed.

d) General compatibility between successive coats must be ensured.

e) Unless otherwise specified, the general colour scheme for finishing coats for different types of equipment and pipelines as per requirement of the Purchaser are to be followed. The colour schemes, however, may be changed, if necessary, by the Purchaser at any stage before the start of the painting of the equipment.

f) In case of Penstock painting, the painting guide lines given in the chapter "PENSTOCK PAINTING".

**04.06.02 PAINTING INSTRUCTIONS**

a) In general, unless otherwise specified, all plant and equipment & pipelines will be given one

coat of antirust primer, lacquers, etc. at the supplier's works after completing surface preparation to remove grease, rust, scales and other foreign materials. The second coat of antirust primer will be applied immediately after erection after completing requisite surface preparation) followed by two coats of finishing paint of approved quality & shade.

b) Technological structures, crane girders & other structures shall be given one coat of primer during manufacturer & one coat of primer after erection followed by two coats of finishing paint.

c) For equipment where original colour as per supplier's practice is desired, both primer & finishing coats will be applied at supplier's works before dispatch of equipment.

d) Structures embedded in concrete shall have no shop painting applied. The portion of the column that is to be embedded in concrete shall be given a coat of portland cement slurry after thoroughly cleaning the surfaces from mill scale, grease & oil immediately after fabrication.

e) The portion of the structures embedded underground shall be given two coats of red lead graphite primer at shop and finished with two coats of bituminous black paint of approved quality.

f) Machined/plained surfaces shall be coated with while lead and tallow before dispatch or before being put into open air & covered with gunny cloth.

g) Surfaces to be site welded shall have no shop paint applied within 100mm of welding zone. After site welding normal painting application will be followed.

h) Areas which become in-accessible after assembly shall be painted before assembly.

i) Cables & other electrical accessories shall have adequate antirust protection.

j) Chequered plates shall be given primer coats only.

k) The phosphate coated surface shall have one coat of baking based and two coats of finished paint of amino alkyd resin stone enamel.

l) External surface of pipe fittings shall be thoroughly cleaned by wire brushing and given two coats of red oxide zinc chromate primer at supplier's works & two coats of final synthetic enamel paint after erection.

m) The equipment which are to be dispatched in knocked down condition and require assembling at site, shall be given two coats of rust and corrosion preventive primer and one coat of synthetic enamel paint of approved quality and shade. After assembly at site, such equipment shall be given one final coat of synthetic enamel paint.

n) The equipment which can be sent as a single block unit duly shop assembled, shall be given full application of paint i.e. two primer coats of rust and corrosion preventive primer and two finish coats of paint of approved quality and shade as per relevant Indian Standards/equivalent international standards.

o) All painting shall be carried out by brushing or roller application with prior permission of the Purchaser.

p) All metal parts not accessible for painting shall be made of rust and corrosion resisting materials. Interiors of equipment will be suitably quoted with anti-rust compounds.

q) The fasteners shall not be painted. These will be dispatched with application of anti-rust compound.

r) Any special painting requirement indicated on the Contractor's drawings by the Purchaser during approval stage shall be binding.

## 04.06.03 SURFACE PREPARATION AND ENVIRONMENTAL CONDITIONS

a) All surfaces to be painted shall be thoroughly cleaned of dirt, grease, rust & mill scale. Removal of rust & scale shall be by hand brushing, power driven wire brushes or by sand blasting, as the surface condition/service condition warrants.

b) The paint shall be applied on the metallic cleaned surface after it is perfectly dry but not later than 3 hours after cleaning of the surfaces. Reasonable time gap should be allowed between any two consecutive coats of primer or finishing coats.

c) Surfaces coming in contact with acid & acidic fumes alkalis, soda, detergents etc shall be cleaned thoroughly to get complete metallic surface as per IS;1477 Part I & II or BS 4232-1967. After sand blasting the surface shall be cleaned with cotton rags, soaked in benzene, to remove fine rust, grease, etc. No sand blasted surface shall be exposed to weather for more than 3 hours.

d) The choice of primer & finishing paint will depend on the environmental condition to which the plant & equipment & pipelines are exposed to.

e) Paints are to be applied on dry surface only under agreeable weather conditions. Painting in damp & foggy weather conditions will not be permitted.

f) For a selected primer the method of surface treatment best suited for that primer & suggestion of paint manufacturer shall be obtained and followed.

g) Zinc rich primer paints which have been exposed for a long time before the finishing coat is applied shall be washed down thoroughly to remove soluble zinc salt deposit.

h) The recommendation of paint manufacturer shall be forwarded to the Purchaser for

approval.

**04.06.04 PRIMER PAINT**

a) In general, two coats of primer paints conforming to relevant Indian Standard or equivalent international standards shall be applied on all unmachined surfaces, except noted otherwise.

b) Where equipment is to be finish painted for dispatch, both coats will be applied before finishing coats at supplier's works.

c) Where equipment warrants finishing coat after erection, one coat will be applied just after manufacture at supplier's works and the second coat just after erection at site after surface cleaning.

d) Equipment on which primer coat has been damaged due to prolonged exposition at site, final erection or transport, shall be given two coats of primer at site before applying finishing coats. Before applying paint the surface will be thoroughly cleaned by sand paper.

e) The primer applied should be compatible in quality and colour schemes with the subsequent finishing coats.

f) Unless stated otherwise, the following primer paints shall be used depending upon the exposition and environmental condition to which the plant & equipment, structures & pipelines are exposed to :

- Aluminium zinc oxide - conforming to IS;2931
- Red oxide zinc chromate - conforming to IS;2074
- Heat resistant aluminium primer paint - conforming to IS:161
- Air drying chemical resistant paint
- Epoxy resin paint (cold cured) -
- Poly urethene paint
- Chlorinated rubber based conforming to DEF-1402, Ministry of Defence

**04.06.05 FINISHING PAINT**

a) Two coats of finishing paint compatible with the primer and conforming to relevant Indian Standard or equivalent international standards shall be applied on all un-machined surfaces unless mentioned otherwise.

b) Unless noted otherwise, the following finishing paints will be applied on plant & equipment, structure & pipelines depending upon the exposition and environmental conditions to which

the plant & equipment, structures & pipelines are on subjected to:

- Synthetic enamel conforming to IS; 2932 exterior type
- Epoxy based finishing paint -
- Heat resistant silicon based Aluminium paint IS:161

c) The finishing paint shall be of approved colour. The undercoat shall have different tinge to distinguish from the finishing paint.

d) The surfaces of the equipment on which finishing coats of paint has been damaged due to prolonged exposition at Contractor's work, erection site, during transport, storage or final erection shall be thoroughly cleaned & touched up with the same paint as applied previously.

**04.06.06 THICKNESS OF COAT OF PAINT**

a) A single coat of paint when dry should have a thickness of 25 to 30 microns (0.025 to 0.030 mm) or 1 mil to 1.25 mils.

b) Total thickness of 4 coats (2 primer coats + 2 finishing coats) should have thickness of 100 to 125 microns (0.100 to 0.125 mm) or 4 to 5 mils.

c) In case of bituminous aluminum gilsonite based paint 3 coats are to be applied. The total thickness of 3 coats will be not less than 100 microns (0.100 mm) or 4 mils.

d) Immediately following the award of the Contract, the Contractor shall submit the names of the proposed paint supplier and applicator together with a quality assurance program for approval. All paints for one section shall be provided by one manufacturer and preferably shall be manufactured in one country to ensure compatibility.

**04.07 CODING SCHEME**

A coding scheme for identifying the drawings, plant and equipment, structures, spares and shipping documents shall be adopted by the Contractor.

**04.07.01 CODING SCHEME FOR DRAWINGS**

A 10 digit drawing numbering scheme is proposed for all the plant and equipment/spares to be supplied. The scheme will be cleared by the Purchaser.

**04.07.02 CODING SCHEME FOR PLANT AND EQUIPMENT/ SPARES (EQUIPMENT IDENTIFICATION NUMBER)**

A 8 digit coding scheme is proposed for all such items of supply. The first 3 digits conform

to the shop complex, next 3 represent the equipment number. Suffixes of 2 digits may be used at the end of six digit, wherever necessary. (Identification number presently used by plant people shall also be given for easy identification number).

**04.07.03 SHIPPING CODE FOR PLANT AND EQUIPMENT/SPARES**

The various items of plant units which arrive at site in packages have to be stored at proper areas/stores so that they can be retrieved easily and also to ensure the completeness of supply proper storing of the packages have to be done without opening the packages. As such, the boxes/packages have to be marked so that the contents may be easily identified for proper storage and easy retrieval.

Shipping code will comprise :

- Code number assigned to the Contractor
- Code number of equipment
- Package SN/total number of packages

**04.07.04 COLOUR SCHEME FOR PLANT & EQUIPMENT**

The Purchaser will indicate the colour scheme to be followed during painting of the plant and equipment. This as well as the equipment identification number will be indicated by the Purchaser soon after the Contractor submits the list of plant and equipment along with GA drawings.

**04.08 ERECTION, TESTING & COMMISSIONING OF PLANT AND EQUIPMENT AND PIPELINES**

**04.08.01 GENERAL**

a. The successful Tenderer, amongst other things, shall be responsible for renovation of the plant equipment to be reused and erection of plant and equipment, fluid system, electrics, auxiliaries, etc. as per the scope of supply within the design limit as given in the Technical Specification.

b. The successful Tenderer shall take delivery of the equipment and transport the same to his store/erection site, maintain his own stores for the storage of equipment and all related documents and records and finally transport the equipment to site for erection. He will take an erection-cum-storage insurance policy covering all the risks including third party liabilities for equipment as well as human life. All security arrangements also shall be made by the Contractor.

**04.08.01**

c. The successful Tenderer shall unpack the cases and do visual checking against physical

damages of equipment and do cleaning of the equipment before start of erection.

d. The successful Tenderer shall be responsible for proper and neat storage and also undertake conservation of all consignments including damaged boxes. During storage of equipment, the successful Tenderer shall take into account deterioration and carry out the re-conservation of the complete equipment/parts/supplies as may be necessary as per the Storage Instructions of the Manufacturer of equipment/components. The successful Tenderer shall also supply the consumables required for such re-conservation work and repair/replace parts required thereof for the proper functioning of the equipment after erection and commissioning.

**04.08.01**

e. Damage/shortage of the equipment/component during transit/transfer/storage, shall be made good by the successful Tenderer without loss of time so as not to upset the agreed erection and commissioning schedule and at no extra cost to the Purchaser. Delay on account of settlement of insurance claims by the Contractor shall not be taken into cognizance by the Purchaser.

f. The successful Tenderer shall be liable to make good any damage to existing equipment and/or facilities caused by the successful Tenderer's personnel. In case any existing equipment or facility is required to be dismantled for erection of the new equipment, the same shall be restored at no extra cost to the Purchaser.

g. The equipment will be installed on the civil foundation provided by the Purchaser/ successful Tenderer r (if specified). However, if any deficiency is noticed in the quality of concreting, dimensions, center-lines, levels, locations, etc of the foundation or anchors bolts or other embedment, the same will be rectified by the successful Tenderer at no extra cost. Minor chipping/minor rectification of the equipment for proper erection, alignment, etc. shall be done by the successful Tenderer. Chipping/dressing of the foundation with air or air and water jet prior to placing the equipment will also be carried out by the successful Tenderer.

**04.08.01**

h. The successful Tenderer shall lay and maintain properly all the temporary supply lines at the erection site for temporary power, water, air connections required for erection purposes, from the points earmarked by the Purchaser for this purpose.

i. The successful Tenderer shall provide all necessary construction tools, compressors, small hand tools, instruments, all commissioning instruments, welding equipment, service bolts, nuts, jigs and fixtures, winches, alignment tools, precision levels etc. and other equipment which may be required for carrying out the erection work efficiently within the time schedule. Unless otherwise specified, the above construction materials shall be the property of the Contractor after the erection work is over. Special tools & tackles obtained by the Purchaser with the equipment will, however, be the property of the Purchaser.

**04.08.01**

j. The successful Tenderer shall provide all temporary ladders, scaffolding materials, platforms, supports and other necessary facilities required for handling, erection and visual inspection of supplies at the point of installation and shall also provide necessary packing plates, wedges, shims, leveling screws, etc. required for erection of plant and equipment.

k. The successful Tenderer shall provide erection consumables like oxygen and acetylene gas, welding rods, solder lugs, oil, grease, kerosene, cotton waste, etc. required for erection of plant and equipment.

l. The successful Tenderer shall erect and maintain his own site offices, main stores and site temporary stores as required for the work and arrange for maintaining in neat manner the area placed at his disposal.

m. The successful Tenderer shall provide sufficient fencing, notice boards and lights to protect and warn others as may be considered necessary by the Purchaser.

n. On placement of order, the successful Tenderer shall provide his scheme for mobilisation with bar chart indicating clearly the resources, of erection machinery man-power and machinery proposed to be deployed to ensure timely completion of work and quality of workmanship.

**04.08.01**

o. The plant and equipment will be erected as per the instructions of the manufacturers/suppliers and under the supervision of the supervisory personnel, to be deputed by the successful Tenderer at site. The successful Tenderer shall also undertake rectification work on account of manufacturing defects, required for proper erection and assembly which can be done at site only according to site condition.

p. The successful Tenderer shall align, level, couple and securely fix all equipment, steel structures, appurtenances and accessories in accordance with drawings and/or instructions.

**04.08.01**

q. All precision survey instruments including leveling instruments shall be arranged by the successful Tenderer

r. The successful Tenderer shall supply materials and carry out flushing and first filling of oil and lubricants, grease, chemicals and as required till successful commissioning.

s. Laying and termination of cables, bus bars, bus ducts and earthing shall be done by the Contractor.

t. Installation and connection of all piping and fittings from the headers termination points to the equipment and inter-connection of all service lines within the design limit after the main headers/termination points shall be successful Tenderer 's responsibility.

u. The successful Tenderer shall check electrical connections to individual items.

v. The successful Tenderer shall be responsible for calibration of all the instruments at site.

w. The successful Tenderer shall be responsible for checking the correctness of erection of mechanical equipment, auxiliary systems, electrical equipment, other equipment, etc. as per the specification and relevant drawings.

**04.08.01**

x. The successful Tenderer shall arrange all facilities at site to undertake radiographic testing and stress relieving of butt welded pipe joints, as required.

y. The successful Tenderer shall be responsible for the management of erection work with proper and adequate supervision for ensuring progress of erection work and quality of workmanship.

z. The successful Tenderer shall deploy required number of supervisory, skilled, unskilled and auxiliary labor as required, for the erection work and comply with such reasonable instructions of the Purchaser in the interest of satisfactory progress and completion of the work according to the schedule.

aa. The successful Tenderer shall be responsible for total commissioning of the Plant including mechanical run, commissioning and demonstration of Performance Guarantee Tests.

**04.08.01**

bb. The successful Tenderer shall organise the work in a manner that other work at site is not impeded and the workmen therein not endangered. He shall arrange temporary access at site, if required, for the erection work.

cc. The successful Tenderer shall intimate the Purchaser/ concerned Plant authorities in writing well in advance about the requirement of shut down of any of the existing units/facilities for inter-connection/ incorporation of additional facilities. The shut down period shall be mutually discussed and finalised. The work to be undertaken during the shut down period shall be planned meticulously by the successful Tenderer to reduce the shut down period to the minimum.

dd. The successful Tenderer shall make temporary arrangement for maintaining the continuity of the services/ facilities before commencement of the diversion of existing service lines wherever shut down is not possible, without any extra cost to the Purchaser.

ee. The successful Tenderer shall return to the Purchaser all crates, packing cases and packing materials and all returnable supplies belonging to the Purchaser at a place designated by the Purchaser at the erection site in the conditions these exist during and after erection work is completed.

**04.08.01**

ff. The tests/checks to be conducted during erection by the Contractor shall be as per the manufacturer's instructions. The Contractor shall attend to the rectification of erection defects, if any, expeditiously. The Contractor shall arrange all testing instruments for such testing at site.

gg. The successful Tenderer shall carry out final painting including supply of paint of the plant & equipment and pipelines, etc. erected as per the instructions of the Purchaser.

hh. Grouting of the equipment on the foundations with shrinkkomp/ferro grout shall be the responsibility of the Contractor.

ii. The successful Tenderer shall indicate to the Purchaser well in advance the requirement of services such as electric power, water, EOT crane, etc. required during construction/erection period.

jj. The Contractor will arrange for the staying facilities of his working personnel.

**04.08.01**

kk. All safety, health and pollution control measures, as required to be adopted as per the Statutory Regulations and the Safety Codes for projects issued along with the tender documents otherwise required or implied by statutory regulations or practices, shall be strictly followed by the Contractor during the execution of the Contract. The Contractor shall set up a suitable safety organisation of his own at site in this regard.

ll. The successful Tenderer shall comply with all Statutory Rules & Regulations with respect to the employment of labour at site including payment of minimum wages as per Govt. rules, deduction of employees's contribution to Provident Funds, depositing the same along with Contractor's contribution to the Provident Fund Commissioner, Employees State Insurance and other statutory deductions/obligations.

mm. At the end of the work the Contractor shall remove all such temporary structures put up by him and hand over the site to the Purchaser in neat and tidy manner.

## 04.08.02 SUPERVISION OF ERECTION, TESTING, COMMISSIONING AND PERFORMANCE GUARANTEE TESTS

a) The successful Tenderer shall depute at site engineer/ specialists from various disciplines for the supervision of renovation erection, testing trial run, commissioning and performance guarantee tests of the plant and equipment under his scope of supply including the foreign

engineers/specialists from various disciplines. The above mentioned Indian and foreign engineers/specialists shall supervise the erection, testing, commissioning and conducting of performance guarantee tests of the plant and equipment with their auxiliaries so as to establish to the Purchaser that the guarantees as stipulated by the Purchaser and agreed by the successful Tenderer are fully met.

b) The Purchaser may place his engineers of respective disciplines to witness successive steps adopted in successful erection, testing, commissioning and performance guarantee tests.

**04.08.03 CONTRACT TERMINAL POINTS**

(i) The successful Tenderer's responsibility for making connections shall be as follows unless otherwise stated in the Specification:

a) Where pipe work and ducting supplied under this Contract connects the equipment already existing or supplied by the Purchaser, the connection shall be made under this contract.

b) This contract includes the terminating and connecting up all cables, which are supplied under this Contract except where noted.

c) All associated existing cabling not included in the Contract will be checked and tested under the supervision of the Purchaser but it will be the responsibility of the successful Tenderer under this Contract to assist the Purchaser in re-checking all final connections and to ensure the subsequent satisfactory operation of the equipment.

(ii) The successful Tenderer shall be deemed not to have fulfilled his obligation insofar as the commissioning of the plant in concerned until complete end-to-end tests have been carried out to the satisfaction of the Purchaser.

**04.08.04 MECHANICAL COMPLETION AND COMMISSIONING**

For Mechanical Completion and Commissioning refer Volume -I /tender specification.

## 05. DESCRIPTION OF THE EXISTING PLANT

### 05.01 EXISTING FACILITIES OF POWER PLANT TO BE USED FOR RM&U

Following facilities already installed are to be used for RM&U with new TG of 1x60MW Kodayar Power House-I.

**~~05.01.01~~ ~~RESERVOIR~~**

| | |
|---|---|
| ~~Name of reservoir~~ | ~~Kodayar Dam – I (Upper)~~ |
| ~~Reservoir area~~ | ~~3.29sq.mile (8.3sq.km)~~ |

| | |
|---|---|
| ~~Max. water level & FRL~~ | ~~+4350 ft~~ |
| ~~Min. draw down level~~ | ~~+4250 ft~~ |
| ~~Maximum storage~~ | ~~2589.8 Mcft~~ |
| ~~Dead storage~~ | ~~3 Mcft~~ |
| ~~Effective storage~~ | ~~2586.8 Mcft~~ |
| ~~Average annual inflow~~ | ~~2211.15~~ ~~cft~~ |

### ~~05.01.02 WATER CONDUCTOR SYSTEM~~

| | |
|---|---|
| ~~**TUNNEL:**~~ | |
| ~~Type~~ | ~~Horse Shoe~~ |
| ~~Diameter~~ | ~~7 ft~~ |
| ~~Length~~ | ~~10400ft (RCC 2040ft + PCC lined 8360ft)~~ |
| ~~**SURGE SHAFT:**~~ | |
| ~~Type~~ | ~~Open plain~~ |
| ~~Surge shaft depth~~ | ~~434 ft~~ |
| ~~Surge shaft Dia~~ | ~~20 ft~~ |
| ~~**PENSTOCK:**~~ | |
| ~~Length~~ | ~~7000 ft~~ |
| ~~Diameter~~ | ~~6′ ~ 4′6″ (1.83 ~ 1.37 m)~~ |
| ~~Thickness~~ | ~~$^{7}/_{8}$″ ~ $1^{1}/_{2}$″ (22.225 ~ 38.10 mm)~~ |

### 05.01.03 POWER HOUSE

| | | |
|---|---|---|
| 1. | Length | 32.91 m |
| 2. | Width | 21.41 m |
| 3. | Height | 19.18 m |
| 4. | Machine hall Floor Level | 358.750 m (1177ft) |
| 5. | Governor Floor Level | 355.40 (1166ft) |

### 05.01.04 STATION CRANE

| | | |
|---|---|---|
| 1. | Capacity | 135/20 Ton |
| 2. | Type | E.O.T |
| 3. | Manufacture | M/s. Hindustan Motor Ltd., Calcutta |
| 4. | Commissioned on | 1968 |
| 5. | Motor Details | |
| a) | Long travel Motor | |
| | Make | Associated Ele. Industries |

| | | |
|---|---|---|
| | HP | 35 |
| | Rating | ½ Hour |
| | RPM | 965 |
| | Voltage | 400/440 |
| | Amp | 49 |
| b) | Cross Travel Motor | |
| | Make | AEI |
| | HP | 7 |
| | RPM | 910 |
| | Voltage | 400/440 |
| | Amp | 22 |
| c) | Main Hoist Motor | |
| | Make | Associated Ele. Industries |
| | HP | 40 |
| | Voltage | 400/440 |
| | Amp | 56 |
| d) | Auxiliary Hoist Motor | |
| | Make | Associated Ele. Industries |
| | Power | 24.5 (Hp |
| | RPM (1/p) | 965 |
| | Voltage | 400/440 |
| | Amp | 35 |

## ~~05.01.05 GANTRY CRANE~~

| | | |
|---|---|---|
| ~~1~~ | ~~Make~~ | ~~M/s. Manning Maxwell and Moore Michg~~ |
| ~~2~~ | ~~RPM~~ | ~~1500~~ |
| ~~3~~ | ~~HP~~ | ~~20~~ |
| ~~4~~ | ~~Voltage~~ | ~~400~~ |

## ~~05.02 EXISTING FACILITIES TO BE DISMANTLED FOR MAKING WAY FOR NEW UNIT~~

~~The complete TG set of the unit is to be dismantled. Following are some of the details of major components.~~

## ~~05.02.01 WATER CONDUCTOR SYSTEM~~

| | |
|---|---|
| ~~BUTTERFLY VALVE:~~ | |
| ~~Dia~~ | ~~1700 mm~~ |

## 06. SCOPE OF WORK, EXISTING FACILITIES& BATTERY LIMIT

### 06.01 SCOPE OF WORK

The broad scope of work for the Unit is as follows.

a) Dismantling of existing TG Set including associated auxiliaries, like cooling water system, governing system, lube oil system, firefighting system etc. and place these at a suitable storage space / yard nearby.

b) Renovate and reuse the Fixed/embedded components: turbine casing, turbine housing/discharge chamber and foundation plates and anchorages.

c) Assess the condition of various existing civil foundations, modification of housing to accommodate the new configured manifold, strengthen and reuse the foundations

d) Collect all the information/dimension, take all measurement, if any, require carrying out for Computerized Simulation Study.

e) Design, Computerized Simulation Study, manufacturing, inspection and testing, supply, packing for dispatch/shipment, freight and insurance, port handling including custom clearance, loading, transportation to site, storing at site, complete erection of all the components testing, commissioning, start up and performance testing and handing over of Unit 70 MW Hydro turbine-generator set(TG set). The TG sets includes Pelton turbine, Synchronous Generator along with associated Auxiliaries; Electrics including Step-up transformer, Unit Auxiliary transformer, Station Service Transformer, Complete new switchyard equipments with unit bay and 2 nos feeder bay and associated equipment; Control& Instrumentation; associated civil work. Tenderer shall ensure that the TG set shall be completed with all materials and equipment whether specifically mentioned herein or not but required for satisfactory operation of the Unit. The design criteria and detailed scope are given in 06.04.

### 06.02 EXISTING FACILITIES OF THE UNIT TO BE DISMANTLED

The following existing facilities of the unit shall be dismantled

a) Turbine and associated auxiliaries, Generator set including the associated equipment up to Generator Transformer in the switchyard and station auxiliary transformer in the back side of power house. The broad details of the existing major equipment have been given in **Chapter-5.**

b) All facilities associated with the above including cables, cable structures, maintenance platforms etc.

c) Transport/shift and place all the dismantled equipment (which are to be newly supplied as per detail scope) to the storage space ear marked for the purpose.

d) (Not all tools required for dismantling are available with purchaser, however tools as available can be used by Contractor, but responsibility of assessment of healthiness of tools will lie with the Contractor)

The broad facilities/equipment to be dismantled are given in **Table** below

| SL. NO. | NAME OF THE EQUIPMENT / FACILITY TO BE DISMANTLED | REMARKS |
|---|---|---|
| | | if any |
| 3. | 110 V DC system Battery and Battery chargers | |

**06.03 EXISTING FACILITIES TO BE RENOVATED AND UTILISED:**

Fixed/embedded components of Unit e.g.turbine casing, turbine housing/discharge chamber and foundation plates and anchorages, Penstock, Drainage and dewatering system, compressed air system, EOT crane of power house are to be renovated and reused.

The required renovation details are enumerated in table below:

| SL.NO. | NAME OF THE EQUIPMENT | DETAILS OF RENOVATION |
|---|---|---|
| 1 | Penstock | As detailed in this chapter |
| 2 | Turbine housing/ discharge chamber | As detailed in this chapter & Sec-B of this Volume |
| 3 | Foundation plates and anchorages | As detailed in Sec-B of this Volume |
| 4 | Drainage and Dewatering System | As detailed in this chapter |
| 5 | Compressed air system | As detailed in this chapter |
| 6 | EOT crane of power house | As detailed in this chapter |
| 7 | Complete Unit area | As detailed in this chapter |

**06.03.01 PENSTOCK**

A. The penstock need to be cleaned and painted with water resistant paint as per the specification detailed below; Anchor blocks are to be repaired; Guide pads are to be refurbished and properly lubricated; All Expansion joints to be replaced with new one. Maintenance platforms are to be painted with weather proof paint if any strengthening is required same shall be carried out by contractor.

i) Internal surface of the penstock shall be cleaned by using brush, water jet and shot blasting. After cleaning the internal surface shall be painted with water resistant paint. For selection of the paint necessary water analysis shall be carried out by contractor. Contractor shall submit a detailed procedure for cleaning and painting for approval from Purchaser.

ii) Outer surface of the penstock shall be cleaned by using brush and water jet. After cleaning the outer surface shall be painted with weather proof paint. Contractor shall submit a detailed procedure for cleaning and painting for approval from Purchaser.

iii) All Expansion joints shall be designed to take care of the expansions between the two consecutive anchor blocks. The material of the convolute of the expansion joints shall be of stainless steel.

iv) Guide pads shall be lubricated as per relevant standard.

necessary instruments etc. shall be provided for operation of governor OPU.

c. Each compressor shall comprise of intercoolers, after coolers, intake air filter cum silencer, discharge valve with NRV, relief valve, and all necessary instruments, Air receiver tank etc.

d. There should be interconnection in between the existing and new compressors through pressure reducing valves so that air can be availed for braking purpose in case of failure of both the existing compressors. These compressors shall be installed at coupling chamber floor. A tentative space is proposed in the equipment layout drawing.

## 06.03.05 EOT CRANE OF POWER HOUSE

The power house consists of an EOT crane with a main hoist of 135 tonnes and auxiliary hoist of 20 tonnes for the erection and maintenance of the unit. For renovation of EOT crane following works to be carried out:

i) Replacement of wire ropes and refurbishing of hoist machinery (gears, gear boxes, sheaves, wheels etc.)
ii) Replacement of power conductors (down shop and/or trolley and bridge)
iii) Replace/provide power disconnecting devices to meet current standards
iv) Replacement of mechanical load brakes with electrical load brakes
v) Replacement of motors
vi) Replacement of control systems
vii) Replacement of control and power wiring or conductor and collector systems.
viii) Replacement of lighting system
ix) (Not used)
x) Re-painting
xi) Load test by certified agency

## 06.03.06 COMPLETE UNIT AREA INCLUDING GENERATOR TRANSFORMER

Cleaning of the area including minor repairs. All surface drains to be discharged in tail pool/discharge chamber whichever is applicable. All existing pipe valves are to be replaced with new except embedded if any.

## 06.04 SUPPLY OF PLANT & EQUIPMENT

The broad scope of supply of new equipment/facility is as follows.

| SL .NO | NAME OF EQUIPMENT/FACILITY | UNIT | QTY |
|---|---|---|---|
| A | MECHANICAL EQUIPMENT | | |
| 1 | Butterfly Valve including complete control system etc. | Sets | 1 |
| 2 | Main Inlet Valve including complete control system etc. | Sets | 1 |
| 3 | Turbine (suitable for producing 70MW at Generator terminals at rated head and discharge) and accessories | Sets | 1 |
| 4 | Governor and its accessories | Sets | 1 |
| 5 | Generator and its associated equipment | Sets | 1 |

| SL .NO | NAME OF EQUIPMENT/FACILITY | UNIT | QTY |
|---|---|---|---|
| 6 | Excitation system & Voltage regulator | Sets | 1 |
| 7 | Cooling water system | Sets | 2 |
| 8 | Lube oil System | Sets | 1 |
| 9 | Compressed air system | Sets | 2 |
| 10 | Fire protection system | Set | 1 |
| 11 | Air conditioning system | Lot | 1 |
| **B** | **ELECTRICAL EQUIPMENT- REFER VOLUME-III OF T.S.** Complete switchyard equipments for unit bay and 2 nos feeder bay with 110 KV BUS | | |
| **C** | **CONTROL & INSTRUMENTATION- REFER VOLUME-III OF T.S.** | | |
| **D** | **CIVIL WORKS** | | |
| | Civil works as per scope | LS | As per Section B of this Volume |
| **E** | **SPARES AND TOOLS & TACKLES** | | |
| 1 | Mandatory spares as per list | Sets. | 1 |
| 2 | Commissioning spares | Sets. | 1 |
| 3 | Recommended spares | Sets. | 1 |
| 4 | Special Tool & tackles | Sets. | 1 |
| 5 | Maintenance tool & tackles | Sets. | 1 |

**06.05 BATTERY LIMITS :**

**The "Battery Limits and Termination Points' shall be as under**

**(i) shall start from Pipe tunnel (downstream of surge shaft) upto tail race on the water conducting system &**

**(ii) shall include complete electric and C&I upto the drives and upto switchyard i.e. CTs and feeder breakers, upto the take off towers of Transmission.**

**06.06 FACILITIES ALREADY INSTALLED FOR THE PROPOSED UNITS**

Tunnel, Surge tank, Penstock, Turbine casing, Turbine housing/discharge chamber, Power House, EOT Crane etc. are constructed/installed and to be utilized for the proposed Unit. The details may be seen from the enclosed Drawings. The approximate dimensions and capacities are given in Chapter-05 of this volume.

For Space available inside power house, refer Drgs. enclosed in Vol-IV.

**06.07 DESIGN CRITERIA AND DETAILED SCOPE OF WORK**

**06.07.01 REFERENCE DOCUMENTS**

- IEC 60041: latest edition, Field acceptance tests to determine the hydraulic performance of hydraulic turbines, storage pumps and pump-turbines

## 09. QUALITY CONTROL, INSPECTION & TESTING

### 09.01 QUALITY CONTROL AND INSPECTION

### 09.01.01 GENERAL

a) Inspection & testing of plant & equipment shall be carried out by TANGEDCO/Purchaser at the works of successful tenderer (Contractor/Sub-contractor(s)) during manufacturing and on final product to ensure conformity of the same with the acceptable criteria of technical specifications, approved drawings, authenticated manufacturing drawings and reference national/international standards.

b) This specification is in addition to provisions laid-down in TANGEDCO/Purchaser's General Condition of Contract (GCC) and special instructions to tenderers, if any.

### 09.01.02 QUALITY ASSURANCE PLAN (QAP)

a) Contractor shall furnish Quality Assurance Plan (QAP) for respective equipment after completion of detailed engineering and finalisation of billing schedule / equipment identification number for TANGEDCO/Purchaser's approval prior to start of manufacturing.

b) QAP shall be prepared and furnished by the successful tenderer in FORM No. 11.20(DQM)F-09 and 10 Rev 0 (enclosed) for structural & mechanical and electrical items respectively in four sets.

### 09.01.03 INDICATIVE SURVEILLANCE BY TANGEDCO

Surveillance level by TANGEDCO shall vary from equipment to equipment as per product below for guidance of contractors in developing QAP.

| SN | Categories of Equipment | Extent of Inspection (as applicable from equipment to equipment) |
|---|---|---|
| i. | Forged, cast, lined products and piping | Material test certificates to be submitted by the contractor at the time of giving inspection call for the main equipment in the final stage. Following checks/tests will be carried out in final stage.<br>Visual inspection<br>Alignment and fitment checking<br>Dimensional checking<br>Witnessing of NDT as per design requirement. |
| ii. | Manufactured items (Mechanical, fabricated and welded) | Material and manufacturer's test certificates to be submitted by the contractor at the time of giving inspection call for the main equipment in the final stage.<br>Visual inspection<br>Alignment and fitment checking |

| SN | Categories of Equipment | Extent of Inspection (as applicable from equipment to equipment) |
|---|---|---|
| | | Dimensional checking<br>Weld inspection – visual and NDT as per design requirement. Radiographs are to be shown and reports to be submitted to TANGEDCO for review during inspection, if applicable.<br>Witnessing of other tests like pneumatic, hydraulic no-load running, functional, balancing, performance etc. depending upon criticality of the part item / equipment. |
| iii. | Bought-out items | Following standard bought-out items shall be accepted on the basis of manufacturer's test certificates.<br>ERW Pipes,<br>if supplied by approved manufacturer's Flowmeters<br>Pneumatic & hydraulic cylinders<br>Insulation materials<br>Bolts, nuts & washers (Grade 4.6). |
| iv. | Electrical equipment | Final inspection & Testing<br>Verification of test certificates<br>Visual & workmanship<br>Dimensional<br>Witnessing of routine tests as per relevant standards. Manufacturer's to be submitted for verification.<br>Witnessing of type/acceptance tests, as applicable |
| v. | Instrumentation | Final inspection & testing.<br>Verification of test certificates<br>Workmanship and visual<br>Dimensional checking<br>Calibration of the instrument for specified parameters shall be checked. |

### 09.01.04 CALIBRATION OF MEASURING EQUIPMENT

All the measuring equipment used for inspection & testing shall be calibrated and appropriate accuracy class of measuring equipment shall be used. Calibration standards used for calibration of measuring equipment shall be traceable to national standards of National Physical Laboratory (NPL), New Delhi with unbroken chains of comparison.

### 09.01.05 CALIBRATION CERTIFICATE OF ALL MEASURING EQUIPMENT

a) Valid calibration certificate for all measuring equipment used during inspection and testing with traceability to national standards of NPL/NPL-accredited laboratories shall be furnished along with inspection call prior to undertaking inspection by TANGEDCO/Purchaser.

b) Calibration certificate shall also indicate reference no. of calibration standards calibrated by NPL/NPL- accredited laboratories and copies of such calibration certificates of calibration standards shall also be furnished when asked for.

### 09.01.06 TEST CERTIFICATES AND DOCUMENTS

a) For each of the items being manufactured, following test certificates and documents, as applicable for each of the equipment, in requisite copies including original shall be submitted to Inspection Agency. All test certificates must be endorsed by the manufacturer and Contractor with linkage to project, purchase order and acceptance criteria.

b) Raw materials identification & physical and chemical test certificates for all materials used in manufacture of the equipment (except IS 2062-1992 Gr. A & IS 210-1993, FG-150).

c) WPS, PQR & WPQ Documents as per applicable code.

d) Details of stage wise inspection & rectification records for fabricated items, castings, forgings and machined articles.

e) Control dimension chart with records of alignment, squareness etc.

f) Manufacturer's material and performance/relevant test certificates for all bought-out items.

- Details of heat treatment and stress relieving charts as per specification.
- Non-destructive Test report as per respective code.
- Static /dynamic balancing certificate for rotating components / machines.
- Hardness test certificate
- Pressure Test Certificates
- Performance Test Certificates for all characteristics.
- Geometric accuracy and repeatability test reports of machine tools
- Routine / type / calibration / acceptance /special test certificates for electrical items.
- Surface preparation and painting certificates.
- Certificates from components authority for the item coming under statutory regulations.

g) Where physical and chemical test certificates of material are not available, the contractor/Sub-contractor shall arrange to have specimens and test samples of the materials. Tested in his own laboratory at his cost and submit the copies of test results in requisite numbers to Inspection Agency for scrutiny and approval. Number of test samples against each heat / cast / lot or batch of materials shall be as per relevant Indian or

International Standards.

h) Where facilities for testing do not exist in the contractor/Sub-contractor's laboratories or in case of any dispute, samples and test pieces shall be drawn by the Contractor/Sub-contractor in presence of Inspection Agency and sealed sample shall be sent to any approved laboratory for necessary tests at Contractor/Sub-contractor's cost.

i) The Inspection Agency shall have the right to be present and witness all tests being carried out by the Contractor-Sub-contractors at their own laboratory or approved laboratories. Also the Inspection Agency shall reserve the right to call for confirmatory test on samples, at his discretion.

**09.01.07 MANUFACTURING AND INSPECTION SCHEDULE**

a) The Contractor shall submit to the TANGEDCO/Purchaser quarterly programme of inspection and tests one month in advance of the commencement of the quarter. The Contractor shall give the TANGEDCO/Purchaser a minimum of 30 days clear notice of any work being ready for inspection and tests specifying the period likely to be required for such inspection and tests.

b) Thereafter, the TANGEDCO/Purchaser or his inspector shall, unless inspection or test is voluntarily waived, attend at the Contractor's or his Sub-Contractor(s)'s premises, such inspection and tests within 7 days of the date on which the equipment is notified as being ready for inspection and test.

c) Should the TANGEDCO/Purchaser fail to attend such inspection and test, the Contractor may proceed with the inspection and test at his option which shall be deemed to have been made in the TANGEDCO/Purchaser's presence and shall forthwith forward to the TANGEDCO/Purchaser copies of inspection/test certificates for acceptance by the TANGEDCO/Purchaser. The proforma and number of copies for inspection/test certificates shall be mutually agreed. However, if the TANGEDCO/Purchaser request the Contractor for a revised date of inspection but within 15 days of the date of inspection as communicated by the Contractor, the Contractor shall arrange the inspection on the revised date as requested by the TANGEDCO/Purchaser.

d) Contractor/manufacturer shall not dispatch any equipment till receipt of MDCC from TANGEDCO/Purchaser.

**09.01.08 INTERNAL INSPECTION BY CONTRACTOR / MANUFACTURER**

a) Inspection and tests shall be carried out by Contractor / Manufacturer in accordance with approved drawings, TS P. O., and approved QAP. Contractor / Manufacturer shall maintain record of each inspection and test carried out and signed documents shall be submitted to TANGEDCO for verification.

b) Contractor shall carry out their internal inspection & obtain clearance from statutory bodies e.g. IBR, CCE, TAC, Weights & measures, safety. IE rules etc. prior to offering any

equipment for TANGEDCO inspection in accordance with approved QAP.

c) Contractor / manufacturer shall ensure use of appropriate calibrated measuring equipment during their internal inspection, as well as make available the same during TANGEDCO inspection and tests. Also they shall make necessary arrangement for access and use of TANGEDCO owned measuring equipment during inspection.

d) Contractor / Manufacturers shall identify all the inspected equipment/component/raw materials & shall maintain the record of status of inspection viz. Inspected & found acceptable, require rectification/rework, rejected etc.

e) The contractor shall establish and maintain procedures to ensure that product that does not conform to specified requirements, is prevented from inadvertent use or installation. The description of non-conformity that has been accepted subsequently by TANGEDCO/Purchaser by concession and/or or repairs, shall be recorded.

f) Repaired and reworked product shall be offered for re-inspection to TANGEDCO along with records of corrective action taken.

g) Contractor / Manufacturer shall not dispatch any equipment till receipt of dispatch clearance from TANGEDCO.

### 09.01.09 METHOD OF ISSUING INSPECTION CALL TO TANGEDCO/PURCHASER

Inspection call shall be floated to respective offices in the enclosed Form No. 11.20 (DQM)F-05/2, REV-0 duly filled in, with ten days clear margin, enclosing all documents like test Certificates, Internal Inspection Reports, P.O., Sub-P.O., T.S., Approved QAP, approved GA drawings/data sheets and manufacturing drawings with a copy of call letter to Inspection Co-ordinating Office, Inspection calls without above documents shall be ignored.

### 09.01.10 OBLIGATIONS OF CONTRACTOR

a) The Contractor shall provide all facilities and ensure full and free access of the Inspection Engineer of TANGEDCO/Purchaser to the Contractor's or their Sub-contractor's premises at any time during contract period, to facilitate him to carry out inspection & testing of the product during or after manufacture of the same.

b) The Contractor shall delegate a Representative/Co-ordinator to deal with TANGEDCO/Purchaser on all inspection matters. Also, Contractor's Representative shall be present during all inspection at Sub-Contractor's works.

c) The Contractor / Sub-Contractor shall provide all instruments, tools, necessary testing & other inspection facilities to Inspection Engineer free of cost for carrying out inspection.

d) The cost of testing welds by ultrasonic, radiographic and dye penetration tests etc. in the

fabrication workshop shall be borne by the Contractor.

e) The Contractor shall ensure that the equipment/assembly/component of the plant and equipment required to be inspected, are not dismantled or dispatched before inspection.

**09.01.11 INSPECTION CERTIFICATE**

a) On satisfactory completion of final inspection & testing, all accepted plant & equipment shall be stamped suitably and Inspection Certificate in standard form shall be issued by the Inspection Engineer for the accepted items. If a final certificate can not be issued, a provisional certificate shall be issued.

b) If the tests were not witnessed by the TANGEDCO/Purchaser or his representative the certificate shall be issued on receipt of the inspection and tests report from the Contractor but not later than 30 days after the receipt of the said report by the TANGEDCO/Purchaser.

c) In the event a certificate is not issued by the TANGEDCO/Purchaser during 30 days, the Contractor, if considered necessary, can arrange dispatch along with the certificate with the clear understanding that if the TANGEDCO/Purchaser reject such equipment at a later date, the Contractor shall rectify the same at his own cost to the TANGEDCO/Purchaser's satisfaction. No Plant shall be shipped or left or otherwise dispatched before such certificate has been issued.

d) The satisfactory completion of these inspection and tests or the issue of the certificate shall not bind the TANGEDCO/Purchaser to accept the work, should it on further tests during or after erection be found not to comply with the Contract.

**09.01.12 INSPECTION WAIVER CERTIFICATE**

For the waiver category of items indentified in the approved QAP, TANGEDCO/Purchaser shall issue Inspection Waiver Certificate after scrutiny of Contractor's internal Inspection Report, Test Certificates and other Documents as identified in QAP.

**09.01.13 GENERAL CLAUSES**

a) The Contractor shall bear all costs of any and all inspections and tests. Where special tests in addition to agreed tests are required by the TANGEDCO/Purchaser, the Contractor shall bear the cost of the testing provided the Contractor is convinced that within this/these special test(s) the quality of the equipment in accordance with the specification can not be proved. If such special tests are necessary based on the results of the agreed test, then cost of all such special tests shall be to the account of the Contractor in all cases.

b. The TANGEDCO/Purchaser upon giving 7 days notice in writing and stating any grounds of objection, shall have the right to reject any or all equipment or demand rectification or replacement thereof.

b) In the case of commissioning spares, operating & maintenance spares and mandatory spares, the same shall be offered for inspection along with the main equipment or after the main equipment has been satisfactorily inspected and tested.

c) TANGEDCO/Purchaser reserve the right to inspect any product at any stage of manufacturing without prior notice to Contractor/Manufacturer beyond pre-identified stages & hold points of approved QAP.

d) Inspection / tests including mechanical running test, material test, performance test shall be carried out and relevant test certificates shall be furnished.

e) All pressure parts shall be hydraulically tested at not less than 150% of design pressure prior to painting and lining. The pressure parts shall be kept pressurised for at least 15-20 minutes at this pressure.

f) All other parts including interconnecting piping shall be hydraulically tested wherever possible as per relevant standards.

## 09.02 TESTING

### 09.02.01 SHOP ASSEMBLY AND TESTS

a) The equipment / components of turbine and generator such as runner, turbine shaft, needle, servomotor, turbine guide bearing, generator shaft etc. shall be shop tested as per relevant National/ International Standards/approved shop assembly drawing .

b) Shop tests of turbine and associated equipment shall be carried out by the manufacturer at their works not limited to the following:

1. Once turbine manufactured first shall be assembled in the shop to the extent possible
2. Static balancing of runners
3. Hydrostatic testing at 1.5 times the maximum working pressure for not less than 15 minutes for manifold, servomotors etc.
4. Non-destructive testing of welds
5. Performance tests for individual auxiliary equipment
6. Complete assembly and simulation of governors
7. Assembly of distribution
8. All motors/pumps/compressors, etc shall be tested as per relevant IS/IEC standards

### 09.02.02 FIELD ACCEPTANCE TESTS

a) The turbine shall be tested at site for establishing fulfillment of guarantees in respect of turbine output & efficiencies including weighted average efficiency. The test shall be carried out as per **IEC – 60041** for field acceptance tests of hydraulic turbine. The arrangement for this test including the testing devices shall be supplied and erected by the successful tenderer.

b) The TANGEDCO/Purchaser at his discretion may call third party for witnessing the tests before acceptance.

c) The field acceptance test shall include testing during erection, certification of the completion of erection of the equipment by the TANGEDCO/Purchaser and tenderer. Equipment wise field quality plan shall be submitted by the tenderer. After completion of erection pre-commissioning checklist points shall be attended by the tenderer. Equipment wise pre-commissioning checklist schedule shall be submitted by the tenderer.

d) After attending the pre-commissioning checklist points the tenderer shall go for commissioning of the equipment as per commissioning procedure and the same shall be submitted by the tenderer before commissioning. After successful commissioning of the complete system the tenderer shall go for PG test as per the TGP approved by TANGEDCO/Purchaser.

e) The successful tenderer shall submit formats of protocol for each of erection, testing and commissioning for approval by TANGEDCO/Purchaser.
If the performance at field is found not to meet the requirement, then the equipment shall be rectified by the Tenderer without any extra cost within the overall time schedule.

**09.02.03 PERFORMANCE GUARANTEE TEST**

- The PG tests for the turbine and generator shall be done for satisfactory performance in accordance with the following standard and TGP approved by TANGEDCO/Purchaser:

- IEC 60545 - Guide for commissioning, operation and maintenance of hydraulic turbines
- IEC 60034 - Rotating electrical machinery and
- IEEE Guide Std 115 - Test procedure for synchronous machine.

- Report & Test certificates shall be submitted to TANGEDCO/Purchaser.
- The PG test shall be conducted by the prospective bidder by arranging Accredited / Reputed third party agencies like IIT, Roorkee, STEAG, etc.

- TANGEDCO/Purchaser or his authorised representative shall be given full access to witness all tests. Prior to performance tests, the contractor shall intimate TANGEDCO/Purchaser allowing adequate time so that if TANGEDCO/Purchaser so desires his representative can witness the test.
- All equipment, measuring instruments including tools and tackles necessary for conducting the performance test to be brought by the contractor / third party agency.
- The contractor shall get approval from TANGEDCO before nominating the third party agency for PG test.
- Necessary additional control/instrumentation points to facilitate third party PG Test shall also be provided as per standards.

**6.41 INSPECTION AND TESTS AT CONTRACTOR'S/ MANUFACTURER'S PREMISES**

The successful tenderer shall give inspection call well in advance for inspection of materials ready for despatch by TANGEDCO/ Purchaser's representatives.

**6.41.1**

a. TANGEDCO or his authorised agent shall have the right of inspecting andtesting the contract work or any part thereof at any stage during the manufacture and the Contractor on demand from TANGEDCO shall carry out such tests in appropriate manner in the presence and free of charge to TANGEDCO/Purchaser in India & abroad. Should the Contractor himself not be in a position to carry out the tests, he shall, on TANGEDCO's demand prepare specimen and samples and send them at his own cost to such testing stations as TANGEDCO may specify and the cost of the test so effected shall be to the Contractor's account. However, cost pertaining to TANGEDCO's inspection personnel shall be borne by the Contractor which includes accommodation and transportation etc.

b. During inspection, the contractor shall assume full responsibilities for all local travel and accommodation for inspecting personnel including visit both in Tenderer's country or elsewhere as required.
c. Similarly, accommodation shall be provided for the trainees also.
d. Should a part of the plant be manufactured not on Contractor's own premises but on other premises, the Contractor shall likewise obtain permission for TANGEDCO/his authorised representative to inspect and test the work as if the said plant were being manufactured on the contractor's premises.
e. The inspection, examination or testing carried out by TANGEDCO shall not relieve the Contractor from any of his obligations under this Contract.
f. In respect of inspection, the decision of TANGEDCO shall be the final.

6.41.2 The inspection and tests shall be so conducted as not to unreasonably impede the progress of manufacture.

6.41.3 TANGEDCO shall have the right to be present during all tests carried out by the Contractor. The Contractor on being requested so to act, shall present sufficient documentary evidence that the material used will meet the specified requirement. If called for, samples and specimen shall become TANGEDCO's property. The Contractor shall notify the contract work, particularly before any assembly, in order that the inspection or tests can be carried out as may be required to ascertain without prejudice to the Contractor's liability, whether the materials and/or services are in conformity with the requirement of the contract. All inspection and tests shall be carried out as per the approved procedure unless otherwise specified.

6.41.4 The Contractor shall bear all costs of any and all inspections and tests. Where special tests in addition to agreed tests are required by TANGEDCO, the Contractor shall bear the cost of the testing provided the Contractor is convinced that within this/these special test(s) the quality of the equipment in accordance with the specification cannot be proved. If such special tests are necessary based on the results of the agreed test, then cost of all such special tests shall be to the account of the Contractor in all cases.

6.41.5 TANGEDCO upon giving 7 (seven)days notice in writing and stating any grounds of objection, shall have the right to reject any or all-equipment or demand rectification or replacement thereof.

6.41.6

a. The Contractor shall submit to TANGEDCO quarterly programme of inspection and tests one month in advance of the commencement of the

quarter. The Contractor shall give TANGEDCO a minimum of 30 (thirty)days clear notice of any work being ready for inspection and tests specifying the period likely to be required for such inspection and tests.

b. Thereafter, TANGEDCO or his inspector shall, unless inspection or test is voluntarily waived, attend at the Contractor's or his Sub-Contractor's premises, such inspection and tests within seven days of the date on which the equipment is notified as being ready for inspection and test. Should TANGEDCO fail to attend such inspection and test, the Contractor may proceed with the inspection and test at his option which shall be deemed to have been made in TANGEDCO's presence and shall forthwith forward to TANGEDCO copies of inspection/test certificates for acceptance by TANGEDCO.
The proforma and number of copies for inspection/test certificates shall be mutually agreed. However, if TANGEDCO request the Contractor for a revised date of inspection but within fifteen days of the date of inspection as communicated by the Contractor, the Contractor shall arrange the inspection on the revised date as requested by TANGEDCO.

6.41.7 In all cases whether at the premises or works of the contractor or of any sub-contractor the contractor shall provide free of charge to TANGEDCO such labour materials electricity, fuel water stores, apparatus and instrument and /or facilities as may reasonably be deemed required to carry out efficiently such tests of the plant in accordance with the contract and shall give all such facilities to TANGEDCO or his authorised representative to accomplish such tests.

6.41.8 When the inspection/tests have been satisfactorily completed at the Contractor's or his Sub-Contractor's premises, TANGEDCO shall issue a certificate to that effect. If a final certificate cannot be issued, a provisional certificate shall be issued. If the tests were not witnessed by TANGEDCO or his representative the certificate shall be issued on receipt of the inspection and tests report from the Contractor but not later than 30 (thirty) days after the receipt of the said report by TANGEDCO.
If the tests were not witnessed by TANGEDCO or his representative the certificate shall be issued on receipt of the inspection and tests report from the Contractor not later than thirty days after the receipt of the said report by TANGEDCO. In the event a certificate is not issued by TANGEDCO during thirty days, the Contractor, if considered necessary, can arrange dispatch along with the certificate as stated in clause 6.31.6 with the clear understanding that if TANGEDCO reject such equipment at a later date, the Contractor shall rectify the same at his own cost to TANGEDCO's satisfaction. No Plant shall be shipped or left or otherwise despatched before such certificate has been issued.

The satisfactory completion of these inspection and tests or the issue of the certificate shall not bind TANGEDCO to accept the work, should it on further tests during or after erection be found not to comply with the Contract.

6.41.9 In case any equipment fails in inspection/tests, re-inspection/retest shall becarried out only after necessary rectification work/replacement by the contractor.

6.41.10 No plant, equipment and material shall be shipped before inspection certificate and despatch instructions have been issued by TANGEDCO/his authorised Inspector.

6.41.11 The Contractor shall furnish to TANGEDCO/his authorised representative five (5)copies of unpriced Purchase Order/ Works Contract s including detailed technical specification and drawings placed on his sub-contractors /sub-suppliers as soon as such orders are placed by the contractor, but in any case not later than two months before the expected date of the equipment getting ready for inspection.

6.41.12 In the case of commissioning spares operating &maintenance spares and insurance spares the same shall be offered for inspection alongwith the main equipment or after the main equipment has been satisfactorily inspected and tested.

6.41.13 In the case of such equipment structural, etc. where tests set forth above cannot be conducted either partially or fully in contractor's/Sub-contractors premises but have to be contracted at site after erection the provisions under this schedule shall also apply However in such cases prior approval of TANGEDCO shall be obtained by the contractor prior to dispatch.

6.41.14 The items under the scope of repair shall also be subject to inspection by TANGEDCO/Purchaser at site /Contractor's workshops. In case it is decided to do Model Testing / CFD analysis the contractor shall include the following cost towards model testing / CFD analysis.

a) Cost towards journey to Contractor's Country & back to India for 2 (two) TANGEDCO Engineers.
b) Cost towards lodging & boarding for 2 (two) TANGEDCO Engineers at Contractor's Country during their stay for required no. of days.

**6.42 PRE SHIPMENT INSPECTION CHARGES**

The pre-shipment inspection charges, if applicable, in respect of imported components at the port of loading / contractor's works, shall be to the account of the contractor/bidder/tenderer.

## 10. DATA, DRAWINGS AND INFORMATION TO BE SUBMITTED

### 10.01 ALONG WITH OFFER

10.01.01 Scope of work with general description of the system and equipment offered specifying the important features. Tenderer shall indicate clearly the work to be carried out in turbine, generator and all other auxiliaries with regard to modifications, additional accessories if required for completion of the job shall be supplied by the contractor without any extra charge, etc. to achieve the rated design capacity.
The description to be accompanied by single line diagrams, and equipment layout to enable the TANGEDCO/Purchaser to have a proper appreciation of the equipment offered and its operation.

10.01.02 Filled in Technical Particulars as given in Ch. 08

10.01.03 Specific Exclusion, if any

10.01.04 Work schedule with bar chart indicating all activities

10.01.05 Main cross section drawing of proposed turbine and generator showing the various components/ parts/ assemblies of the turbine to the extent possible.

10.01.06 Layout drawings of the power house showing the overall dimensions and layout of turbines, clearly indicating unit spacing, dimensions of turbine distributor, etc., and all important elevations

10.01.07 Description of lubrication system along with drawings

10.01.08 Physical and schematic drawings of excitation system and AVR along with descriptive literature.

10.01.09 The general arrangement and overall dimensions of the generators, exciters and bearings, ducts, cable and piping etc.

10.01.10 Charts, Curves and Hill Curves showing performance and cavitation characteristics of the turbine.

10.01.11 Generator Characteristic Curve showing performance of generator

10.01.12 Schematic Diagram and Block Diagram of bearing oil lubrication system, Cooling water System, Drainage /Dewatering system, Compressed Air System, Brake Air System, Fire Protection System

10.01.13 Detailed write up of Microprocessor based digital governor

10.01.14 Physical & Schematic drawings and descriptive literature on the governor and governing mechanism.

10.01.15 Block diagram of excitation and governor control system with start/stop sequence of the plant with control levels.

10.01.16 Phase-wise requirements of power for construction, erection/testing and commissioning activities.

10.01.17 List of performance tests proposed by the tenderer to demonstrate the guaranteed parameters for turbine, generator, electrical equipment and other auxiliaries in addition to tests/checks given in the specifications.

10.01.18 Technical catalogues of equipment offered.

10.01.19 List of annunciation considered in turbine panel, generator desk and in common aux. panels.

**10.02 AFTER PLACEMENT OF ORDER**

The list of Data/Drawing/Documents to be submitted by Successful tenderer for approval, information will be intimated to the successful tenderer.

## 11. LIST OF PREFERED MAKES

The Tenderer shall have to select any of the sub-vendors from the list of preferred makes only and no deviation to this effect will be entertained during the execution of the contract unless a specific approval has been obtained for by the Tenderer from the TANGEDCO/Purchaser.

| Sl. No. | EQUIPMENT | Preferred Makes |
|---|---|---|
| ~~1.~~ | ~~PUMPS~~ | ~~KI RLOSKAR/KSB/MATHER & PLATT/WPIL~~ |
| 2. | MOTORS | NGEF/BBUGEC/BHEUKEC/ JOYTI/ABB |
| ~~3.~~ | ~~SOLENOID VALVE~~ | ~~ASCO(INDIA), SEITZ-ROTEX, SCADER DUNCAN~~ |
| ~~4.~~ | ~~INSTRUMENT CABLES~~ | ~~CABLE CORP., FINLOEX CABLES, TOSHNIWAL CABLES~~ |
| ~~5.~~ | ~~GATE, GLOBE, BALL VALVE~~ | ~~AUDCO, DEZURIC, TIFLIN, SAKHI INTERNATIONAL, BDK~~ |
| ~~6.~~ | ~~DUPLEX FILTER~~ | ~~OTOKLIN, SUPERFLO, FILTERATION ENGINEERS~~ |
| ~~7.~~ | ~~PRESSURE CONTROLLERS~~ | ~~SAIL, TISCO, AJANTA TUBE, MAN INDUSTRIES, MUKAND~~ |
| ~~8.~~ | ~~PLUG VALVES~~ | ~~AUDCO, DEZURIC, TUFLIN~~ |
| ~~10.~~ | ~~COMPRESSOR~~ | ~~ATLAS COPCO/ IR/ ELGI/ KPC~~ |

## ~~12. SALIENT FEATURES~~

| ~~Sl.No.~~ | ~~SALIENT FEATURES~~ | | |
|---|---|---|---|
| ~~1.~~ | ~~Name of the Dam/Weir~~ | ~~Kodayar Dam - I~~ | ~~Kodayar Dam - II~~ |
| ~~2.~~ | ~~Location~~ | ~~K.K.District~~ | ~~K.K.District~~ |
| ~~3.~~ | ~~River~~ | ~~Kodayar~~ | ~~Kodayar~~ |
| ~~4.~~ | ~~Purpose~~ | ~~Fore Bay Dam~~ | ~~Fore Bay Dam~~ |
| ~~5.~~ | ~~Catchement Area~~ | ~~29.12 Sq.km~~ | ~~29.01 Sq.km~~ |
| ~~6.~~ | ~~Type of Dam/Weir~~ | ~~Masonry Gravity~~ | ~~Masonry Gravity~~ |
| ~~7.~~ | ~~Height~~ | ~~87.78 m~~ | ~~61.00 m~~ |
| ~~8.~~ | ~~Length~~ | ~~166.0 m~~ | ~~152.40 m~~ |
| ~~9.~~ | ~~Length of Earthern Dam Left Flank~~ | | |
| ~~10.~~ | ~~Right Flank~~ | | |
| ~~11.~~ | ~~Reservoir F.R.L.~~ | ~~1325.90 m~~ | ~~350.52 m~~ |
| ~~12.~~ | ~~Reservoir M.W.L~~ | ~~1325.90 m~~ | ~~350.52 m~~ |
| ~~13.~~ | ~~Reservoir M.D.D.L.~~ | ~~1295.40 m~~ | ~~318.82 m~~ |
| ~~14.~~ | ~~Reservoir Capacity at~~ | ~~3.0 Mcft.~~ | ~~3.23 Mcft.~~ |

# RENOVATION, MODERNISATION AND UPRATING OF KODAYAR POWER HOUSE - I IN TIRUNELVELI GENERATION CIRCLE

## FROM 1x60 MW TO 1x70 MW

## KANYAKUMARI DISTRICT, TAMILNADU, INDIA

## INTERNATIONAL COMPETITIVE BIDDING
## TENDER SPECIFICATION NO. HE. 2367

# VOLUME III OF IV

# ELECTRICS AND CONTROL & INSTRUMENTATION

OFFICE OF THE
SUPERINTENDING ENGINEER
HYDRO (ELECTRICAL)
5th FLOOR, EASTERN WING
NPKRR MAALIGAI,
144, ANNA SALAI, CHENNAI - 600 002.

# CONTENTS
# VOLUME-III

# SECTION - A
# ELECTRICS

## 01. SPECIAL INSTRUCTIONS TO TENDERERS

### 01.01 COMPLIANCE WITH SPECIFICATION

01.01.01 All equipment and accessories covered under this specification shall conform to `Technical Specifications' given in this document.

01.01.02 All equipment shall be suitable for voltage/freq. variations and other data given in Electrical System Design.

### 01.02 STANDARDS AND REGULATIONS

01.02.01 The design, manufacture, performance , testing and installation ( including safety, earthing and other essential provisions) of equipment and accessories covered under this specification shall, in general, comply with the latest issue of:

- Applicable Standards and Codes of Practices published by Bureau of Indian Standards.
- Central Board of Irrigation and Power
- Indian Electricity Act.
- Central Electricity Authority
- Indian Electricity Rules.

01.02.02 Equipment complying with other recognised Standards such as IEC, BS, VDE, DIN etc. will also be considered if it ensures performance equivalent to or superior to Indian Standards.

01.02.03 Equipment and accessories for which Indian Standards are not available, shall be designed, manufactured and tested in accordance with the latest issues of recognised Standards such as IEC, BS, VDE, DIN etc.

01.02.04 In case of conflict between applicable Standards referred to in this part and the Technical Specifications given in other clauses, the latter shall govern to the extent of such difference.

### 01.03 MAKE & INTERCHANGEABILITY

01.03.01 This specification is issued for renovation / procurement of specified equipment and system. The tenderer shall furnish division list of supplies from foreign and Indian sources indicating the name of the agency or make against the respective items. It shall be the responsibility of the successful tenderer to arrange the import license for the imported items offered and to coordinate the supply of equipment from

foreign and Indian sources and execute the contract within the agreed time schedule.

01.03.02 The make of major equipment shall be limited to preferred makes indicated under clause 'List of preferred makes'.

01.03.03 Makes of all other equipment and accessories are subject to prior approval by the purchaser.

01.03.04 Similar equipment and components shall be of same make; equipment of same type and rating shall be interchangeable.

01.03.05 The purchaser has the option of selecting the manufacturers of electrical equipment, instruments and controls and any other specialised items in the interest of standardisation and the successful tenderer shall have to supply equipment of the particular make, if so required.

**01.04 SAFETY**

01.04.01 All equipment shall be complete with approved safety devices wherever a potential hazard exists and with provision for safe access of personnel to and around equipment for operational and maintenance functions. The design shall include not only those usually furnished with elements of machinery but also the additional covers, stairways , ladders, steel structural platforms for operator's control panels, handrails, partitions etc. which are necessary for safe operation of the plant.

01.04.02 All danger and caution notice boards' shall be both in Hindi, Tamil and English languages.

01.04.03 The Contractor must take sufficient care in moving his construction plants and equipment from one place to another so that those may not cause any damage to the property of the Purchaser particularly to the overhead and underground cables and other service lines.

01.04.04 When the work is carried out at night or in the obscure day light, adequate arrangements for flood lighting in the working area shall be made by Contractor at his own cost and got approved by the Purchaser / TANGEDCO.

01.04.05 The safety posters/regulation for prevention of accidents shall be displayed by the Contractor at appropriate places. Notices and warning signs shall be displayed for all sources of dangers.

01.04.06 All electrical drives and equipment must be equipped with safety devices. The safety provisions shall conform to the recognised standards, safety codes and statutory regulations.

01.04.07 All safety measures as required to be adopted as per the statutory regulations and the safety rules of the plant shall be strictly followed by the Contractor during the execution of the Contract.

01.04.08 Adequate number of first aid boxes as defined in the State Factory Rules shall be provided and maintained at all work sites.

## 01.05 CODING/ NUMBERING SCHEME

A coding scheme for identifying the drawings, plant and equipment, structures, spares and shipping documents shall be adopted by the contractor in a sequential manner. The objective shall be to provide the following :

- Streamlined archives management
- Effective control with respect to identification of equipment and drawings to be supplied by different contractors/sub-contractors.
- Identification of the spare parts for easier inventory control.

## 01.06 COMPLIANCE WITH RULES, REGULATIONS, AND OBTAINING STATUTORY APPROVAL

a) All equipment/materials shall be installed in accordance with the requirements of relevant standards, Indian electricity Rules and Acts and also the Factories Act. It is the responsibility of the tenderer to see that the electrical installation supplied and erected by him shall be to the entire satisfaction of Chief Electrical Inspector, Central Electricity Authority or any other statutory body having jurisdiction in the area and also to the owner/ TANGEDCO.

b) The responsibility for obtaining the Electrical Inspectorate's approval for the installation and modifications to be carried out rests entirely with the contractor. It shall be the responsibility of the contractor to prepare and submit all necessary drawings, calculations, test certificates and relevant details (other than those given by the owner/TANGEDCO) to the Electrical Inspector and obtain prior approval for commencing the work and for the complete installation work done.

## 01.07 INSTRUCTION MANUALS

01.07.01 Instruction manual shall give step by step procedure for :

1. Erection, testing and commissioning
2. Operation
3. Maintenance and
4. Repair.

**01.07.02 MAINTENANCE INSTRUCTION SHALL INCLUDE:**

1 Diagnostic trouble shooting / fault location charts
2 Tests for checking of proper functioning.
3 Periodic Maintenance schedule.

**01.07.03 INSTRUCTION MANUAL SHALL ALSO CONTAIN:**

1 Manufacturer's catalogues with ordering specification for all items.
2 List of consumables with specifications, brand names and annual consumption figures.
3 Drawings relevant for erection, operation, maintenance and repair of the equipment.
4 Procedure for ordering spares.

~~arrangement each connected to new battery charger. Each outgoing circuit shall have MCCB.. Each outgoing circuit shall be connected to both the sets of bus bars through selector switch. All cables shall be provided new.~~

**~~02.02.04.08~~ ~~UPS~~**

~~a. A UPS of adequate capacity shall be provided for Control and instrumentation system. The UPS shall be a static type and shall have dual redundancy of electronic parts/system. UPS shall be on line back up facilities.~~

**02.02.04.09 CABLING (CABLES, CABLE SUPPORTING MATERIALS, TRAYS, ETC,)**

a. All HT/LT Power, control cables and cable accessories supporting structures, cable installation, cable terminations with necessary junction boxes and fire sealing are under the scope of tenderer for all areas covered in the package.

~~b. 11kV cables shall be provided for the following :~~

- ~~Generator to Generator Transformer~~
- ~~Station Auxiliary Transformer~~
- ~~Excitation Transformer, etc.~~

c. All LT cables shall be replaced with new of adequate size and requirement. Existing cables shall be removed and placed in proper condition in a place identified by the purchaser's store

d. All control and protection cables required for connection to relays, meters, signaling alarm, control, monitoring etc. shall be provided, laid glanded and terminated at both ends by the tenderer. Existing cables shall be removed and placed in proper condition in a place identified by the purchaser's store.

e. All erection/installation accessories, cable termination and jointing kits, cable fixing, dressing, tag numbers, route markers, supporting materials for all equipment covered in the package shall be part of the tenderer's scope.

f. Selection of components and cable size for MCCs shall be as per chart /details given in Annexure-I/tender specification.

g. Tenderer shall have to submit the layout indicating location of all major electrical equipment and cable routes including levels of floor, clearances, entry/exit points, cable structure details during detailed engineering stage.

**02.02.04.10 MISCELLANEOUS (ILLUMINATIONS, PDB, EARTHING MATERALS, LOCAL PUSH BUTTON STATIONS, JUNCTION BOXES, LT MOTORS)**

**~~A.~~ ~~ILLUMINATION~~**

~~a) Existing fixed type Lighting distribution board located behind C&R panel in control room shall be dismantled and stored at a place as specified by Engineer in Charge. New Main Lighting.~~

b) New floor mounted Lighting Distribution Board shall be provided with two incomers and area wise outgoing feeders. Incomers and outgoing feeders shall have MCCBs. The distribution of lighting power supply for the individual areas within battery limit shall be done at 415V, 3 phase, 4 wire bus system through Main Lighting Distribution Boards (MLDB). Auto changeover shall be provided for incomers. Area wise Lighting distribution board shall be provided.

c) Illumination of power plant inside area including Main Control room, Machine hall, Coupling chamber floor and Cooling water pump floor. Light fittings shall be selected considering aesthetic look and requirement. Light fittings near all equipment within battery limit shall be provided

**B. POWER DISTRIBUTION BOARD (PDB) / ACDB**

415V, 3 phase, 4 wire, 250A, 40 kA (short time rating for 1 sec.) indoor type PDB /ACDB shall be provided to cater the auxiliary loads.

**C. EARTHING MATERIALS**

New GI flexible/flats are to be provided for connecting all equipment to existing earth grid. Electronic earthpit shall be provided for electronic equipment.

**D. LOCAL PUSH BUTTON STATIONS AND JUNCTION BOXES**

Local control station for all drives shall be provided. Selector switch for local as well as remote (from Control room) shall be provided.

**E. LT MOTORS :**

a. 415V AC energy efficient motors shall be provided to all auxiliaries covered under this specification as per system requirement.
b. AC squirrel cage industrial motors shall be fed at 415V, 3 phase, 50 Hz, with DOL start as applicable.
c. For motors above 30 kW rating star delta starter shall be provided.

.

**02.02.04.11 CONTROL SYSTEM**

a) Existing Control desk, relay and metering panels of generator, generator transformer Control & Relay Panel and AVR shall be dismantled and stored at a place as specified by Engineer in Charge.

b) A Distributed control system shall be provided as detailed in Sec B of this Volume. Electronic portion of governor and AVR control shall be compatible to the overall system requirement.

c) The automation control shall have normal operation control, Governor control, process protection control.

**VI) INSULATORS :**

**A) DISC INSULATOR**

a) The insulator discs shall be cap and ball pin type with Ball and Socket coupling suitable for use in suspension of tension strings.

b) The electrical and mechanical characteristics of the Disc Insulator shall conform to specific technical parameters of this specification

**B) POST INSULATOR**

a) Post Insulator shall be suitable for upright mounting on steel structures. The electrical and mechanical characteristics of the Post Insulator shall conform to specific technical parameters of this specification

b) The Hardware fittings for Suspension / Tension string shall be supplied complete in all respect and all metal parts shall be galvanized.

**VII) STEEL STRUCTURES AND SUPPORTS, NUT AND BOLTS**

Complete steel structures for mounting various equipment of switchyard shall be provided

**VIII) ALUMINIUM TUBULAR PIPE BUS**

Aluminum tabular busbar of 3" diameter for 110kV switchyard at Kodayar Power House-I shall be provided.

**IX) ACSR CONDUCTORS**

ACSR Zebra Conductor shall be provided for 110 kV Switchyard.

**X) CLAMP, CONNECTORS**

All clamps connectors shall be designed suitable to the specification for Aluminum Tubular pipe bus and specification for ACSR Moose/Panther conductor as applicable.

## 02.03 ELECTRICAL SYSTEM DESIGN

### 02.03.01 GENERAL

**A. STANDARDS**

a) The design, manufacture, assembly and testing as well as performance of the equipment shall conform to the relevant IS specifications (latest revision). In case the tenderer is not in a position to comply fully with certain IS specifications, or in respect of certain items for which there are no IS specifications, the tenderer may base his proposals on IEC/BS/VDE/DIN recommendations or other reputed national or international standards subject to the approval of the purchaser/TANGEDCO.

b) All equipment supplied and all work done including system design and detailed engineering shall also comply with the statutory requirements of the Government of India, the Government of Tamil Nadu and with the Indian Electricity Rules.

**B. CLIMATIC CONDITIONS**

a) The climatic conditions generally prevailing at Kodayar have been described in volume–I.

b) Electrical Equipment selection and derating shall generally be based on ambient temperature of 50 deg. C.

**02.03.02 DESIGN CRITERIA**

The standardized voltage levels as given in table below shall be adopted.

**A. STANDARD VOLTAGE LEVELS -TABLE:**

| Sl.No. | Description | Voltage level |
|---|---|---|
| 1. | Evacuation and Transmission | 110 kV, 3 phase, 3 wire 50 Hz, effectively earthed |
| 2. | Station supply | 415 V, 3 phase, 4 wire, 50 Hz, effectively earthed. |
| 3. | A.C. Drive motors | 415 V, 3 phase, 4 wire effectively earthed |
| 4. | Metering | 110 V, AC PT. voltage |
| 5. | Control & protection gear | 220 V, AC 2 wire from UPS |
| 6. | Panel lighting and space heaters | 230V, 1 phase, 2 wires 50 Hz, A.C. with point earthed. |

PERMISSIBLE VARIATIONS

The system unit/plant equipment shall be designed suitably for variation in voltage and frequency as indicated in Table below.

**B. VARIATION IN VOLTAGE AND FREQUENCY-TABLE**

| Sl.No | Description | Voltage | Frequency |
|---|---|---|---|
| 1. | Permissible variation For LT system with rated performance/ rated current and control | + 6% to - 6% , | +3% to - 5% |
| | For HT system effectiveness system maintained | + 6% to - 9% , | + 3% to - 5% |
| | For EHT system | +10% to -12.5% | + 3% to - 5% |

| | | | |
|---|---|---|---|
| 2. | Permissible variations for control and regulation equipment with rated performance and control quality maintained. | +/- 10% , | +3% to - 5% |
| 3. | Permissible voltage dip at LT switchgear bus for starting of LT motors | - 5% | |

BASIC INSULATION LEVELS

Equipment shall be designed suitably for basic insulation levels as given in Table below.

**C. BASIC INSULATION LEVELS-TABLE**

| Sl.No | Nominal voltage kV | BIL kV (peak) |
|---|---|---|
| 1. | 110 kV | 550 |
| 2. | 11 kV | 75 |
| 3. | 400 V | 1.1 |

**D. SYMMETRICAL SHORT CIRCUIT RATINGS**

The three phase symmetrical short circuit ratings of the switchgear at different voltage levels will be as indicated in Table below.

**SYMMETRICAL SHORT CIRCUIT RATINGS –TABLE-D**

| Sl. No. | Voltage level | Symmetrical Breaking capacity | Making |
|---|---|---|---|
| 1. | 110 kV | 40 kA | 100 kA |
| 2. | 11 kV | 40 kA | 100 kA |
| 3. | 400 V | 30 kA | 75 kA |
| 4. | 220 V DC | 10 kA | - |

The rated short circuit withstand duration for switchgear of 110 kV is 1.0 sec and for 11 kV it will be 3 Secs whereas for 400 V including MCCs it will be 1 sec.

**E. MOTOR STARTING AND PERMISSIBLE VOLTAGE DIPS :**

Voltage dip on starting of the largest motor shall be limited to 15% of the nominal voltage at the motor terminals.

**F. SYSTEM EARTHING**

110 kV systems is effectively earthed. 415 volt system will be effectively earthed in line with IE Rules.

**G. OTHER REQUIREMENTS**

a) The electrical distribution scheme to be provided will be subject to approval of purchaser/purchaser's TANGEDCOs.

b) Miscellaneous items such as relays, type of relays, relay ranges, number of poles for relays, scale of meters, CT ratios, links, fuses, switches, indication lamps, terminal blocks, aux. relays, timers associated with main relays, size of control cables shall be supplied as per the approved scheme/to achieve scheme requirements.
c) All LT /HT CTS shall be of 5A secondary and EHT CTs shall be 1 amp. secondary. Control cable from CT to panel shall of 2.5 sq.mm. copper.
d) All erection/installation accessories, cable termination and jointing kits, cable fixing, dressing, tag numbers, route markers, supporting materials for all equipment shall be part of the tenderer's scope.
e) Motor space heater (if required) power supply shall be fed from Distribution board. Space heaters will be interlocked with motor main power supply.
f) Earthing mat is already provided for complete power plant area. Existing earthing connections/ strips needs to be checked for continuity and to be refurbished / extended if needed for making suitable to connect all equipment in the scope of tenderer.
g) Selection of components and cable size for MCCs shall be as per chart given in Annexure-I.
h) Tenderer to submit a system wise drive list indicating process interlocks, permissive conditions etc. with places and mode of control for each drive control system philosophy with provision of various control, indication, measuring devices at various places. This shall be approved by the purchaser/TANGEDCO. Based on above approved philosophy tenderer shall have to provide all equipment/materials and prepare a control scheme/logic diagram.
i) Above mentioned control philosophy and interlocking logic shall be prepared as per the technological requirement.
j) Control room shall be air conditioned. Tenderer shall include in his scope dummy panels for switchgear and control panels, wherever civil beam blocks cable entry to panel.
k) For control protection requirement a 220V UPS shall be provided.
l) One no. 220V DCDB common for all three unit and emergency lighting shall be provided

**02.03.03 DESIGN OF ELECTRICAL AUXILIARY SYSTEM.**

a) The electrical auxiliary system shall be designed considering available short circuit levels, switchgear duties and voltage dips on auxiliary buses for the various operating conditions. The impedance values of transformer shall be selected with a view to limit the fault levels and voltage dips.

b) Manual transfer of auxiliary loads shall be provided during unit starting and during planned shutdowns, whereas fast automatic transfer shall be provided between the station and unit aux. buses of 415 V switch boards.

**02.03.04 POWER DISTRIBUTION SCHEME**

a) The electrical power distribution and control scheme shall be based on the scheme elaborated below. Tenderer shall follow the system design in general on these lines and design the equipment based on criteria given in earlier paragraphs. The generators shall generate power at 11 kV. The generators shall be directly connected to 110 kV system through 3 nos. single phase 11/110 kV transformers. The electrical distribution scheme shall be based on unit and station auxiliaries system feeding separately.

b) The unit loads shall be fed directly through 300 kVA, 11/0.415kV transformer, whereas for station auxiliaries, the power shall be fed through 1 nos. 500 kVA transformer for the entire plant. The scheme is shown in single line diagram and is further elaborated in the following paras.

**02.03.05 POWER EVACUATION**

The switchyard is existing and located adjacent to power plant building, to interconnect the power plant to grid at 110 kV for the purpose of power evacuation.

**03. PERFORMANCE REQUIREMENT AND GUARANTEE**

03.01 The tenderer shall study the specification and satisfy himself thoroughly regarding the workability of the plant, equipment and systems offered and also take full responsibility for the guaranteed operation and performance of the same as well as for their smooth, safe and reliable working.

03.02 All equipment shall be guaranteed for workmanship, materials design and satisfactory performance to the parameters in accordance with the specification document and relevant clauses of the General Conditions of Contract. The guarantee for performance shall cover individual items and systems for their ratings / outputs.

03.03 The tenderer shall also guarantee the integrated operation of all the systems and equipment covered in his scope as a whole including interfaces required to be established with other related systems and equipment.

03.04 The supplier shall conduct performance / acceptance tests on each of the major items of equipment supplied to demonstrate that the equipment and system supplied are capable of achieving the performance parameters specified and contracted for, in accordance with the General Conditions of Contract. The total system performance shall also be guaranteed and demonstrated.

03.05 Should the tests specified show that the unit has failed to achieve the guaranteed parameters, the supplier shall carry out necessary modifications or part replacements to achieve the guaranteed parameters and for successful demonstration the tests shall be repeated.

DC distribution board : As per requirement or minimum outlets of 14 nos. of double pole switch outlets of 15 Amps rating.

Exact rating to be furnished for required loading and calculation to be submitted.

## ~~04.11 UNINTERRUPTIBLE POWER SYSTEM (UPS)~~

~~a) A UPS of adequate capacity shall be provided for Control and instrument system of Unit. The UPS shall be a static type and shall have dual redundancy of electronic parts/system. UPS shall be ON LINE back up facilities~~
~~b) Two nos. 110% capacity converters shall be provided which shall consist of dry type transformer and rectifier panels.~~
~~c) Output of converters shall be connected to DC bus and through rectifier DC battery supply shall also be connected to the above bus. Battery capacity shall be for 2 hour back up~~
~~d) Two nos. 110% rated inverters shall be connected to DC bus and output of inverters (IGBT based) shall be connected to AC bus of UPS.~~
~~e) Tenderer to calculate the requirement/capacity of the system and furnish alongwith the bid.~~
~~f) UPS batteries shall be sealed maintenance free type (Lead Acid) and shall be suitable for site condition.~~
~~g) All equipment shall be naturally air cooled.~~
~~h) All active device shall be solid state.~~
~~i) The nominal AC input supply shall be 415 V 50 Hz, 3 Phase.~~
~~j) A bypass static switch with transformer etc. shall be included to provide continuity of supply in the event of UPS failure and transfer time shall be less than 1/4 cycle.~~
~~k) For abnormal operating conditions alarm shall be provided in CR panel and as well as on UPS Panels.~~
~~l) System shall be suitable for 125% rated output for 15 minutes~~

## 04.12 ELECTRIC MOTORS

### 04.12.01 LOW VOLTAGE SQUIRREL CAGE INDUCTION MOTORS :

**A. CONSTRUCTIONAL FEATURES:**

a) Frame sizes and ratings and other facilities as per IEC
b) For motor frames upto 315, cast iron or steel construction body; for frames above 315, steel construction shall be used.
c) Casing feet to be integral with the motor body.
a. Degree of protection for motor, bearings and terminal box to be IP-55.
b. Cylindrical shaft ends, unless otherwise specified
c. Shaft extension as per requirement.
d. For motor of rating upto 5 kW, Ball bearings shall be used for both DE & NDE end. For ratings above 5 kW the DE end shall be provided with roller bearing

and NDE end shall be provided with ball bearing.

e. Bearings shall be suitable for running of motor in either direction.

**04.12.01 .B. TERMINAL BOX:**

a) Terminal box suitable dimension to receive copper cables and provided normally on the right side as viewed from drive side or on the top as per the requirement.
b) Terminal box frame with opening for cable rotatable by 4x90 deg.
c) A suitable earthing stud shall be mounted inside the terminal box.
d) Terminal Box shall be suitable to receive the aluminium cables as given in Table-I.
e) Extension of Terminal box as required shall be done to receive the Aluminium cables to avoid cramping of the cables in the terminal box.

**04.12.01.C COOLING:**

a) Motors shall be of TEFC design.
b) Ventilation shall be effective irrespective of direction of rotation.

**04.12.01.D. QUALITY OF OPERATION:**

a) Motors shall be dynamically balanced with full key on the shaft- end and fan.
b) Vibration intensity shall be limited as per IS 4729.
c) Continuous noise level should not exceed 85 db A at a distance of 1.0 m from motor body

**04.12.01 .E. ELECTRICAL DESIGN**

a) Suitable for DOL starting

b) Motors suitable for being switched on to a solid main even at phase opposition at a maximum residual voltage of 50% i.e. the motor shall be capable of withstanding 150% of the rated voltage.

c) Motors capable to start and run-up at a minimum of 85% of rated voltage at its terminals with the driven mechanism/equipment connected.

d) Capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% of the rated voltage at its terminals.

e) Starting torque shall be not less than 160% of rated torque.

f) Starting current shall be less than or equal to six times the rated current.

g) Motor shall be capable of withstanding locked rotor current for at least 5seconds longer than the starting time at 80% voltage under rated load conditions.

h) Continuous duty motors shall be capable of three equally spread starts per hour under normal condition or two starts in quick succession from cold or one hot start, under rated load condition.

i) Motors provided with class 'B' or class 'F' insulation. Permissible temperature shall be limited to 120 deg. C in case of class 'B' insulation and in case of class F insulation, permissible temperature shall be $130^0$C as measured by resistance method. Class H insulation shall be considered in specific cases. Limiting temperature shall also be limited to 130 deg C in case of Class H insulation as measured by resistance method.

j. Motors selected shall be of normal starting torque type, high starting torque type, high slip type or stall torque type as required for the specific application.

k. Four pole motors to be used for all general applications, unless specific drive requirement or economy calls for other poles.

## 04.12.02 VALVE ACTUATORS

a) The actuator shall be designed for operation on 400V, 3 phase, 50 Hz system.

b) The actuators shall be suitable for voltage frequency variations as indicated under Clause 'Electrical design criteria'.

c) The actuators shall consists of motor, torque/ position limit switches, clutch, hand wheel, position indicator, space heater.

d) The actuators enclosure shall be totally enclosed dust tight, water proof without the necessity of any canopy.

e) Insulation of the drive shall be class `B'.

f) Two torque limit switch one for each direction and four for end of travel limit switch (two for each direction) shall be provided.

g) Hand wheel shall declutch automatically when motor is energised.

h) Position transmitter, potentiometer type shall be provided for remote indications wherever required.

i) Internal wiring shall be of 1.5 sq.mm copper wire, however, terminals for external connections shall be suitable for 2.5 sq.mm

j) Motor data sheet for each type of motor actuator shall be furnished alongwith internal wiring diagram, suggested control schematic and torque limit switches contact development.

## 04.13 CABLES, CABLE TRAYS AND SUPPORTS

### 04.13.01 CABLE SPECIFICATION

Types of cables of following grades and general specifications shall be used taking into consideration the application requirements. All cables shall have FRLS (Fire Retardant Low Smoke) PVC compound for inner and outer sheath.

**Type 1 : 11 kV (UE) XLPE Cables**

11 kV (UE) heavy duty power cable, 3-core, with compact circular stranded (rm/V) copper. conductor with extruded conductor shielding of semiconducting material, XLPE insulated, with insulation shielding over individual cores consisting of extruded semi- conducting compound followed by lapped semi conducting material and copper tape, cores stranded together with a holding tape provided with a common covering of extruded inner FRLS sheath of type ST2 compound, galvanised round steel wire armoured and FRLS PVC outer sheath of type ST2 compound as per IS : 7098 (Pt-II)-1973 as amended upto date. Copper screen shall be suitable to carry 1 kA E/F current for one second.

**TYPE 2 : 1.1 KV, XLPE COPPER POWER CABLES**

Type 2.1 : 1.1 kV, heavy duty power cable multicore with standard sector shaped (sm) or with compact circular stranded (rm/V) or circular stranded (rm) copper conductors as applicable, XLPE insulated suitable for 85 deg. C. operation as per IS:7098-1973, core stranded together provided with a common covering of FRLS PVC inner sheath of type ST2 PVC compound, galvanised round steel wire armoured and FRLS PVC outer sheathed of type ST2 PVC compound conforming to IS:1554 (Part-I) - 1976, as amended upto date.

**TYPE 3 : 1.1 KV PVC COPPER CONTROL**

Type 3.1 kV circular stranded (rm) annealed copper conductor, PVC insulated of type A PVC compound suitable for $70^0$C operation, as per IS:5831-1970, cores stranded together provided with a common covering of FRLS PVC inner sheath of type ST1 PVC compound, galvanised steel armoured and overall FRLS PVC sheathed of type ST2 PVC compound and multi-core to IS : 1554 (Part-I) - 1976, Type YWY ST1.

### 04.13.02. CABLE SELECTION :

01. The cable selection should be as per TANGEDCO specification.

a) In general, cables for LT drives shall be selected as per Annexure-I, however, size and type of cables for specific applications shall be selected giving due consideration for the following:
b) Thermal heating effect/permissible current carrying capacity.
c) Voltage drop
d) Short time current/overload requirement

e) Protection system grading and short circuit current carrying capacity.
f) Ambient conditions
g) Cable grouping factors
h) In selection of the cable following ambient conditions shall be taken into account.
i) Cables laid directly in ground in single way ducts or pipes buried underground.
j) Thermal resistivity of soil : $150^0$C cm/W

k) Soil temperature : $40^0$C

l) Depth of laying (to the highest point of cable or grade cables and top surfaces of ducts) : 75 cm for 1.1kV
90 cm for HT cables

m) Horizontal formation axial : 15 cm in case of spacing cables laid directly in ground in a group and approximately touching in case of single way ducts or pipes.

n) Cables laid in free air/in conduits in free air.
Ambient air temperature for the respective shops. : $40^0$C & as specified

o) Cables laid in ventilated ducts/gallery
Ambient air temperature : $40^0$C.

p) The minimum cross sectional area for HT power cables shall be 185 sq.mm.

q) The minimum cross-sectional area of the cables used in LT power circuits shall be 6 sqmm per core if with aluminium conductor or 4 sqmm per core if with copper conductor. Maximum cable size shall be 185 sq mm for motors and 240 sqmm for incomers to MCCs, PCCs etc.

r) For power supply to moving mechanisms subject to vibrations, flexible copper cables preferably single core should be used. In these cases, a separate core should be provided for earthing. Cables used for circuits of tacho-generators, brakes, solenoids, field windings and secondary windings of measuring transformers shall be copper conductor with cross-sectional area not less than 2.5 sqmm per core. All control cables shall have copper stranded conductors except for mobile and portable equipment where control cables shall be of flexible type. Copper cables shall be used for all cranes/hoists.

s) For control circuits, PVC insulated and FRLS PVC sheathed multicore cables with copper conductors having a minimum cross-sectional area of

2.5 sqmm per core shall be used. The number of cores may be standardized as 2,3,4,5,7,10,14,19,24.Each core of control cable with 7 core and above shall be numbered at every 1 meter intervals.

t) In multi-core control cables, the following minimum reserve cores shall be kept at the engineering stage:

i) Upto 7 cores - One reserve core
ii) 10 cores - Two reserve cores
iii) 14,19 & 24 cores - Three reserve cores

u) Sequential length marking shall be provided in outer sheath of all power and control cables.

v) Standard drum length for all types of power and control cables shall be offered.

w) ISI marking at every meter of cable length shall be provided.

x) Cores of multi-core control cables shall be serially numbered.

y) For all cables, extra length of 2 metres will be left before jointing.

**04.13.03 ADDITIONAL TESTS ON CABLE**

a) To prove the fire retardant low smoke characteristics, the following additional tests shall be conducted at works on any size of each type of cable namely, H.T/ power, L.T. power, control and instrumentation cables.

b) Oxygen index test as per ASTM D 2863. Minimum value of Oxygen index shall be 30.

c) Flammability tests on finished cable as per the requirements of IEEE-383 and IEC-332-1.
Smoke generation by inner/outer sheath fire as per ASTM D 2843. The cables shall meet the requirements of light transmission of a minimum of 40% after the test.

**04.13.04 CABLE TERMINATION & JOINTS**

Following type of cable termination and joints shall be used for XLPE cables in indoor and outdoor applications :

1. Tapex type
2. Heat shrinkable type
3. Pre moulded push on type

**A. TAPEX TYPE SYSTEM :**

The stress grading material shall be wrapped around the cable core, over lapping the edge of the outer conducting layer. The tape layer shall fuse together to form a compact rubber body around the stress grading material and cable core and thereby exert an active pressure on cable.

**B. HEAT SHRINKABLE TYPE SYSTEM :**

The stress control and grading wherever necessary shall be by means of semi conducting heat shrinkable tubing. Environmental sealing between heat shrinkable material and cable surfaces shall be achieved by using hot melted sealants or adhesives. Where such sealants or adhesives shall be exposed to high electrical stress, same shall be track resistant type.

**C. PREMOULDED PUSH ON TYPE SYSTEM :**

I. Premoulded refers to moulded Ethylene Propylene Diene monomer rubber components. Sealing between the premoulded push on material and cable surface shall be achieved by semi conducting pad which has cold flow properties.

II. The termination and straight joints for HT/LT cables shall be supplied in kit form. The kit shall include all insulating and sealing material apart from conductors fittings and consumable items. Necessary devices required for termination and joints shall be provided.

**04.13.05 CABLE LAYING:**

i) Hot dip galvanized cable supporting structures, GI cable trays (ladder type and perforate type), cable racks, other associated accessories and fire sealing materials for laying, termination and sealing of cables under contractor's scope of supply.
ii) Cable supporting structure and cable trays
iii) Cable supporting structure and cable trays for cables to be installed in existing cable gallery / trenches
iv) All the support structures will be hot dip galvanized.
v) Contractor will lay separate trays for laying different type of cables like power, control and screened cables. Fire protection paint will be provided for all cables when crossing walls, structures etc and also at regular intervals.

**04.14 MISCELLANEOUS**

**04.14.01 ILLUMINATION**

**04.14.01.01 GENERAL**

The lighting system inside and outside Power House are designed based on the desired minimum illumination levels recommended by IS and the practices followed in industries, architectural arrangement, building dimensions including mounting height, environmental considerations, ease of maintenance and reliability of the lighting distribution network.

Illumination will be provided in all premises of Power House peripheral lighting, area lighting, street lighting, etc within battery limit.

The illumination system will include the following in required quantities;

- Lighting DBs
- Light fittings with lamps
- lighting fixtures and accessories
- Cables and wiring
- Ceiling fans
- Receptacles
- Switches
- Conduits
- Brackets
- Hangers
- Clamps
- JBs

The illumination system shall be designed as per IS:3646-1992. The minimum level of illumination, type of fittings, maintenance factor to be considered is as given below:

| Area | Type of Light Fittings& Lamps | Lux level (min) |
|---|---|---|
| Control room with false ceiling | Decorative mirror optic luminaire for recessed mounting with energy efficient CFL 2x36W of Philips type FBS 450/236 M2 HF (with MASTER PL-L 36W/840/4P ICT lamp) OR equivalent. | 300 |
| Office Room without False Ceiling | Surface mounting luminaire suitable for 2x28 Watt TL-5 lamp ( Philips model TCS 3502 XTL5 – 28Watt EB C5 or Equivalent) | 300 |
| Civil Staircases of plant building | General purpose batten luminaire with energy efficient T5 lamps 2x28W of Philips type TMS 122/228 E HF (with MASTER high efficiency TL5-28W/840 lamp) OR equivalent. | 100 |
| Flood lighting | Weather proof non integral type (integral type in case of high mast) flood light fittings suitable for 1x250/400W HPSV lamps of Philips type SNF 114 250/400W wide beam /narrow beam as per requirement OR equivalent. | 70 |
| Machine Hall | Surface/Suspended type high performance integral open medium bay luminaire with prismatic diffuser comprises of polycarbonate reflector & separate control gearbox complete with 1 No. HPIP 250 Watt Lamp etc as required (Philips Model HPK 205 1xHPI – BU250W PR or Similar) | 200 |
| Electrical rooms without false Ceiling | Surface mounted / Suspended luminaires suitable for T5 lamps 2x28 W of Philips type TPS 814/228 D8 HF/ TPH 824/228 I HF (with MASTER high efficiency TL5-28W/840 lamp) OR equivalent. | 200 |
| Battery Room | Surface mounted luminaire with energy efficient T5 lamps 2x28Watt of Philips type TMS 122/228 E HF with GMS 122 /228 Reflector (With MASTER high efficiency TL5 – 28 W/840 lamp) OR Equivalent | 100 |

| | | |
|---|---|---|
| Toilets | General purpose batten luminaire with energy efficient T5 lamps 1x28W of Philips type TMS 122/128 HF (with MASTER high efficiency TL5-28W/840 lamp) OR equivalent. | 100 |

a) In addition to above following light fittings shall be used as per architectural requirement / as per requirement

1. Recess mounting direct lighting luminaire suitable for Compact fluorescent lamps PLL 36 Watt anti glare, D-6 optics, pearl white wing (Philips model FBS 580 2xPL – L36W EB TOD DF-WH or Similar).
2. Recess mounting accent light suitable for 1 no. 50 Watt halogen lamp (Philips Model QB 026 XMA/ 50 Watt/12GU5 3WH or Similar)
3. Surface mounting type mirror luminaire suitable for 13 Watt CFL lamp (Philips model No. 13W / 34094 /11/86 or Similar)
4. Indoor Bulk head luminaire suitable for 1no. 9 Watt CFL lamp complete with all accessories like reflector, protection guard, holders (Philips model FXC 101 1xPL-5 Watt or Similar)

b) The light fittings shall be complete with all accessories like electronic ballast, reflector etc. External area lighting including street/road lighting / tower lights shall be fed from Outdoor type Feeder Pillar located at suitable places. Switchyard cum transformer yard lighting shall be done on suitable masts. All supporting structures for the mast lighting shall be included along with light fittings and cabling accessories. The fittings shall be with 250W HPSV. The light mast shall be similar to the existing masts of switchyard. Lux level shall be 100. Automatic switching ON/OFF of these circuits shall be done through timers.

c) Flood light towers shall be fed through 415/240V, 3 phase, 4 wire circuit with individual fittings distributed at 240V, single phase, with control and protection located at bottom of each tower. DP MCB in a sheet steel box shall be provided near each fitting to facilitate removal of lamp in off position.

### 04.14.01.02 LIGHTING POWER DISTRIBUTION

The distribution of lighting power supply for the individual areas within battery limit shall be done at 415V, 3 phase, 4 wire bus system through Main Lighting Distribution Board (MLDB). The outgoing feeders of the MLDB shall feed the required numbers of Sub Lighting Distribution Boards (SLDBs) for lighting. Each SLDB shall receive power at 415V AC, 3 phase, 4 wire and distribute it into 240V, 1 phase circuits for connection to the lighting fixtures and 240V receptacles. The SLDBs shall be located in the rooms, bays, etc preferably near entry/exit. covering the respective zone. The SLDBs shall be
located in the electrical rooms in the respective area. Separate neutral chamber shall be provided for neutral busbar inside SLDB.

### 04.14.01 .03 CONTROL ROOM ILLUMINATION

Control room illumination shall be provided with decorative fittings mentioned in above table flushed to the false ceiling. Decorative type two numbers 60 watt light

fittings shall also be provided as emergency lights. Lux level of control room shall be 400. Light fittings layout and their type shall be approved during detail engineering.

Cables/Wiring and switches -

In control room, wiring shall be above the false ceiling and PVC conduits shall be used on side walls. 3 nos. 240V, 3 pin socket outlets with plug tops and switches shall be provided. In switch board 16 Amp MCB as incomer shall be provided and decorative type ON/OFF switches shall provided for each fitting.

**04.14.01.04 EMERGENCY LIGHTING**

This will be provided by emergency AC/DC Lighting fixtures located strategically in control room, S/S areas and emergency exits. These lights will be ON all the time, normally from station supply. In case of failure of normal AC system, these lights will be energized from the Station DC supply through automatic switching. The changeover in the reverse direction shall also be automatic. All equipment/ cabling required to achieve above shall be included by tenderer. All DC emergency lighting shall be through incandescent lamp. Quantity of DC emergency lighting fixtures shall be 20% of the normal lighting fixtures. Also it shall be suitable for 3 hours duration.

**04.14.01.05 OUTDOOR LIGHTING :**

Complete illumination of the outdoor area including Switchyard, transformer, MIV area, Road, Power House Periphery illumination is s to be done with LED amps with fittings/ HPSV/ fluorescent lamp with fittings mounted on poles/structures /Power House periphery etc. to meet the required lux level.

**04.14.01.06 ILLUMINATION OF OTHER AREAS DURING ERECTION**

In existing Power House indoor and outdoor illumination has been provided however at certain locations within battery limit additional fittings needs to be provided during erection stage to facilitate the work.

~~**04.14.01.06 A. SPECIFICATION OF MAIN LIGHTING DISTRIBUTION BOARD (MLDB)**~~

~~**A. GENERAL**~~

| | | |
|---|---|---|
| ~~Type~~ | ~~:~~ | ~~- Metal clad~~<br>~~- Shall be suitable for 415/240V, 3phase and neutral.~~<br>~~- Non draw out type~~ |
| ~~Construction~~ | ~~:~~ | ~~- Modular Construction.~~<br>~~- Fully Compartmentalized with metal/ Insulating material partition.~~ |
| ~~Enclosure class~~ | ~~:~~ | ~~- IP52 .~~ |
| ~~Type of execution~~ | ~~:~~ | ~~- Single front~~ |

| | | | |
|---|---|---|---|
| 4.0 | Indication Lamps | | LED type indicating lamps for :- |
| | | - | MCCB ON/OFF/TRIP. |
| | | - | Power ON R / Y / B . |
| 5.0 | Meters | | |
| | | - | 144 sq.mm size voltmeter |
| | | - | 144 sq.mm size ammeter |
| | | - | MFM with communication features. |
| 6.0 | Current transformer | - | 3 numbers for metering . |

**04.14.01.06.F. OUTGOING FEEDER ARRANGEMENTS**

| | | | |
|---|---|---|---|
| 1.0 | Circuit breaker | - | Three pole microprocessor based MCCB with LSIG release. |
| 2.0 | Indications | - | ON/OFF/TRIP indication lamp. |

**04.14.01.06. G. PANEL WIRING**

| | | |
|---|---|---|
| Power / current | - | 1.1Kv grade single core, black colour PVC transformer circuit insulated , stranded conductor of Minimum size 2.5 sq.mm copper |

**04.14.01.07. SPECIFICATION OF SUB LIGHTING DISTRIBUTION BOARD (SLDB)**

**A. GENERAL :-**

| | | |
|---|---|---|
| Type | - | Metal clad |
| | - | Shall be suitable for 415/240V, 3 phase and neutral. |
| Construction | - | Totally enclosed. |
| | - | Dust & vermin proof. |
| | - | Welded back and sides |
| Enclosure class | - | IP54 . |
| | - | IP 55 (with canopy) for outdoor installation |
| Type of execution | - | Single front |
| Mounting | - | Wall mounting . |
| Installation | - | Indoor / Outdoor (with canopy) |

**04.14.01.07.B. CONSTRUCTIONAL FEATURES :-**

1.0 Sheet steel CRCA, Thickness 2 mm .

2.0 **CABLE ENTRY**

- Incomer :- Bottom cable entry.
- Outgoing :- Top / Bottom cable entry.

**3.0 DESIGN**

- One Incomer and outgoings .
- All the components shall be accessible from front
- Access to the operating handle of the incoming isolating switch shall be from the front of the cubicle without opening the front door.

- Operating knobs of outgoing MCBs shall be accessible only after opening the front door of the cubicle.
- Protective insulated cover plate (3 mm thick bakelite sheet ) shall be provided inside the cubicle to shroud all the live parts .

**4.0 GLAND PLATE :**

Undrilled detachable gland plates (3 mm thick) shall be provided at the top and bottom with suitable gaskets for cable entry

**5.0 EARTHING**

Two separate earthing terminals shall be provided

**04.14.02 POWER DISTRIBUTION BOARD (PDB) / ACDB**

a) 415V, 3 phase, 4 wire, 250A, 40 kA (short time rating for 1 sec.) indoor type.
b) Board shall be single front, metal clad, front matched, dust and vermin proof fully compartmentalized and extensible on both sides, IP51 type enclosure.
c) Shall have base channel of size ISM 75.
d) Shall have isolated busbar chamber for main busbar at the top, running throughout the length of the board. Chamber shall have removable cover.
e) Cable alley shall have sufficient space for aluminium power cables and bottom cable chamber shall be left free completely isolated from the vertical busbars.
f) Busbars shall have same cross section throughout the length . Rating of the neutral busbar shall be 50% of the main busbar. Earth bus bar shall run in bottom chamber throughout the length of the panel.
g) The number of PDBs and their locations shall be decided based on consumers and shall be finalised during drawing approval stage.
h) Generally all boards will have following feeder arrangement :
i) Incomer - 250A load break switch
j) Outgoings - 32A - 4 nos. MCB (TPN)
   1. 16A - 4 NOS. MCB (TPN)
   2. other as per the need of tenderer.
k) ACDB shall have two incomers with ammeter, voltmeter, & in outgoing one of each type of feeder shall be provided as spares.

**04.14.03 LOCAL CONTROL STATION**

a) Near all drives local control stations shall be provided.
b) Sheet steel construction, dust and vermin proof, wall/structure mounting.
c) Control switches, push buttons and indication lamps mounted on front hinged gasketed and lockable door.
d) Suitable knockouts with glands on the bottom or top cover for cable entry.
e) Terminals to be suitable for 2 cores of 2.5sq.mm conductors with 20% spare terminals.
f) Readily accessible shrouded terminals.
g) Wiring with extra flexible wires.

h) Stop push button to be lockable type with mushroom head.
i) Inscription in English on corrosion resistant metal strips.
j) Enclosure conforming to IP-54 class for indoor and IP55 with canopy for outdoor.

**04.14.04 ERECTION, INSTALLATION ACCESSORIES**

All support structures required for cables, for electrical equipment including conduits, inserts, shall be provided to complete the erection job in all respect. Cable tag markers, clamps, sealing compound, pull boxes, marshalling boxes etc. shall be considered as part of the tenderers scope.

**04.14.05 OTHER ITEMS**

All required safety items like rubber mats in front of LT board, shock treatment chart, Two nos. first aid boxes shall be provided in each electrical premises.

**04.15 SWITCHYARD EQUIPMENT**

Complete switchyard equipment for 2 Nos. feeders and 1 Unit bay :

Switchyard equipment shall be supplied as per the Single line Diagram (SLD).
Necessary Civil and Structure works required in this regard and any other works / supply for successful commissioning of Switchyard & RMU of PH shall be under the scope of the Contractor.

**04.15.01 GENERAL**

Existing 110kV switchyard shall be modified keeping in mind of new three numbers Single phase 11/110kV, 3x27MVA Generator Transformer (GT) in place of existing three single phase 3x22.5 MVA transformer.

**04.15.02 LIGHTNING ARRESTORS**

**A. TYPE :**

- Station class, heavy duty, gapless lightning arrestor
- Non linear resistor type
- Self supporting type in single pole assembly
- Suitable for pedestal mounting
- Outdoor type suitable for installation in open yard.
- Shall be designed to provide maximum protection against lightning and switching surges.

**B. TECHNICAL PARTICULARS**

| | | | |
|---|---|---|---|
| a) | Nominal system voltage | : | 110 kV |
| b) | Highest system voltage | : | 123 kV |
| c) | Rated Arrestor voltage | : | 96kV |
| d) | Frequency | : | 50 Hz |
| e) | Power frequency withstand test voltage | : | 230 kV |
| f) | Impulse voltage | : | 550 kV peak |

**4.16.19 INVERTER :**

**4.16.19.01 1. THE INVERTERS SHALL COMPLY WITH THE FOLLOWING SPECIFICATION AND CHARACTERISTICS:**

| | |
|---|---|
| TYPE | Type of inverter On Line µP controlled IGBT based Static inverter |
| Rating @ 50 °c of each inverter | 120% of assigned load or 3 KVA whichever is higher. |
| Type of power switching | Pulse width modulation |
| No. of inverters | 2 nos to operate in redundant configuration with automatic switch over in case of failure of one unit. |
| Input Voltage | 220V DC +/- 10% taken from station battery banks |
| Output voltage | Single phase 230V AC + /-1% |
| Nominal frequency | 50 Hz |
| Frequency regulation i) Free running | 0.01 HZ |
| Total harmonic distortion of output voltage | Less than 2.5% for linear load & Less than 5% for non-linear load |
| Single harmonic of output voltage | Less than 3% |
| Power factor range | Rated 0.8 (0.6 to Unity, within KVA & KW) |
| Method of cooling | Forced air cooling |
| Assigned Load | Servers, Engineering Workstation, Metering PC, LAN Equipments pertaining to Level-2, Printers Etc. |
| Alarm | Dry contact for minor and major alarm |

Note: A worksheet depicting the total calculation of the assigned load should be furnished in assessing the rating of the inverter.

2. The Inverters shall comply with the following Characteristics:

i) The inverters shall normally operate in synchronism with the mains AC power source. Upon loss of the mains AC power source or its frequency deviating beyond a preset range, the inverters shall revert to their own internal frequency standard. When the mains AC source returns to normal, the inverters shall return to synchronized operation with the mains AC source. Such reversal of operation of inverters from synchronous to free running mode and vice-versa shall not introduce any distortion or interruption to the connected loads. A suitable dead band for frequency may be provided to avoid unnecessary frequent reversal of inverter operation between free running mode and synchronized mode under fluctuating frequency conditions.

ii) For safe operation in the event of Power failure or input source voltage dropping below preset value, necessary safeguard software shall be built in for proper shutdown and restart.

iii) The inverters shall be synchronized to the main AC source unless that source deviates from 50 Hz by more than 1% (adjustable to "1/2/3/4/5%).

iv). The inverters shall provide interrupter switch to isolate the unit from the load on failure of the unit. The interrupter switch shall be rated to carry full continuous load and to interrupt the inverter under full fault load.

v). The inverters shall be capable of supporting a start-up surge or overload of 150 % of rated output for up to 60 seconds.

vi). The transient voltage response shall not exceed "4% for the first half-cycle recovering to 1% within ten cycles for a 100 percent step load application or removal.

3. Separate Control panel for “Auto-Manual-Inverter Bypass” selection of AC supply to load should be provided. Inverter-1 shall be powered by 220V DC-1 source and Inverter-2 by 220V DC-2 source. Control panel drawings should be furnished for TANTRANSCO approval. This is a turnkey project and the inverter scheme should be implemented holistically including the said control panel.

The scope of supply, installation, testing and commissioning of inverter also includes All the necessary AC Distribution boards, DC Distribution boards, Control panel to facilitate manual change over, auto change over and bypass mode with meters for monitoring the voltages.

4. **TYPE TESTS FOR INVERTER:**

The inverter shall comply to IS 13314 / Equivalent standards as applicable for the KVA required for the project. This includes the following tests.

1. Visual inspection test
2. High voltage test
3. Insulation resistance test
4. No-load test
5. Output test
6. Climatic tests
7. Harmonic contents test
8. Radio frequency interference test for conducted emission in the AC output circuit.

~~**4.16.20.0 LAPTOP COMPUTER FOR SCADA TOOL**~~

| | |
|---|---|
| ~~Type~~ | ~~Reputed make laptop computer~~ |
| ~~Processor~~ | ~~Latest generation intel processor ,3 GHz or Higher~~ |
| ~~Software~~ | ~~1.Windows latest operating system. 64 bit or higher.~~<br>~~2. Antivirus software package validity for entire project guarantee period.~~<br>~~3. HMI software for client access to SCADA HMI.~~<br>~~4. MS office suite latest version.~~<br>~~5.All other necessary software for configuration of SCADA devices, control & protection panels devices.~~ |

c) Earthing mat consisting of earthing electrodes and cross connecting conductor is already provided by the purchaser and tenderer has to connect equipment earthing to the grid. Existing earth pits shall be renovated and rusted materials shall be replaced with equivalent material and bimetal washers shall be provided wherever GI strips shall be connected to existing copper network.

d) For protective earthing separate conductor shall be used for flow of earth fault current as elaborated below.

e) The LV side neutrals of the power / distribution transformers shall be connected to two separate earthing electrodes. They shall also be connected with the neutral bus of the corresponding switchgear and in turn switchgear neutral bus shall be connected to the earthing bus of the switchgear. The protective conductor for connection from switchgear earthing bus to MCCs/DBs and further to motors shall be either through fourth core of cable or armouring of cable. In case of armouring on cable, same shall be double steel wire armouring. The fourth core or armour of cables and all conduits for cables shall also be connected to the earthing mains. A continuous earth strip shall run in each side of cable channel and in cable ducts and trenches.

All joints in the run of the main earthing conductors will be welded or brazed type. Connection to equipment structure shall be bolted type.

**04.18.08. CONDUCTOR SIZES FOR EARTH CONNECTIONS :**

**A. HIGH VOLTAGE SYSTEMS - 75 X 5 MM GI FLAT FOR :**

- Transformers
- Earthing resistors
- Earthing leads to earth electrodes.

**B. LT SYSTEM WHERE THE VOLTAGE DOES NOT EXCEED 650V NORMALLY :**

- 6 Sq.mm Stranded GI wire for :
- Motors and starters upto and including 2.2kW, shunt limit switches, push buttons and master controllers, Light fitting, JBs, PBs, etc.
- Instruments and miscellaneous small items protected by fuses of ratings not exceeding 15A.
- 16 Sq mm Stranded wire for :
- Motors and starters above 3.7 kW and upto and including 15 kW.

**C. 25 X 3 MM GI FLAT FOR:**

- Motors and starters above 15 kW, and upto and including 45 kW
- Control desks, cabinets, LCB, socket outlet isolators, SLDBs/DBs.

**D. 50 X 6 MM GI FLAT FOR :**

- Motors and starters over 45 kW
- Switchboards, MCC,PDB,PCC MLDB.

**E. 50 X 6 MM GI FLAT (MINIMUM) FOR :**

- Main earthing ring in plant buildings
- LT transformer neutral
- LT Switchboards and other equipment protected by circuit breakers.

**04.18.09 SHEET METAL ENCLOSED PANELS CONTROL DESKS AND BOXES**

a) The base frames of all panels, desks, posts etc., shall be welded to structures or to the civil inserts provided on the floor/walls. Fabrication of supports/ frames, wherever required, shall be done by the tenderer.

b) The shipping section shall be placed in position before removing the protective covering to eliminate scratch/damage. The shipping section shall be moved by using rollers under the shipping skids wherever lifting cranes are not available. The contractor shall do the assembly at site as per manufacturer's general arrangement drawings and installation instruction. While assembling a complete board comprising several unit type cubicles, the board as a whole shall be aligned. The panels shall be properly levelled prior to grouting the holding down bolts or welding the panels to the inserts. All interconnection of busbars and wiring between the panels shall be done as per manufacturer's instructions and drawings. Welding work on the panels shall only be carried out after consultation with the purchaser. Damage to the paint due to welding shall be rectified by the contractor.

**04.18.10 TRANSFORMERS**

a) The transformer and its accessories and mountings like radiators, conservator, thermometers, silicagel breathers, marshalling box, rollers etc., delivered at site in separate packages, shall be assembled at site after cleaning by the contractor in proper sequence as per manufacturer's drawings.
b) Jacks shall never be placed under valves or cooling tubes.
c) Suitable stopper shall be provided both in front as well as rear of transformer to keep the transformer stationary in its position.
d) The oil conservator and the pipes shall be erected as shown in the manufacturer's drawings.
e) Before the transformer is filled/topped with oil, oil samples shall be checked by the tenderer from each container. The oil shall possess the dielectric strength as per relevant IS. Oil shall be filled upto the mark shown.
f) The contractor shall also test the oil from each transformer to determine its suitability for use. If required, the contractor shall carry out drying and filtering operations as per IS code of practice to ensure that moisture is completely removed and the oil is free from impurities. This may be carried out by using oil filtering equipment to be provided by the tenderer having vacuum as well as heating arrangement. Only after the dielectric strength of oil and other parameters

are checked and approved, the external connections shall be made to the transformers.

g) The dial thermometers shall be screwed to the thermometer pockets after removal of the blind plugs.

h) All necessary cabling shall be connected before charging of the transformer. This will include signaling cables upto marshalling box and from marshalling box to meters, if not already done.

i) Any modifications to HT and LT terminal box to accommodate the number of cables or bus duct to be terminated shall be carried out by the contractor. Naked light and flame shall never be used near the transformer. Instructions given by the manufacturer's erection & commissioning manual shall also be followed.

**04.18.11 BUSBAR**

a. Busbar installation shall be commenced from the middle section and the buses shall be fastened without tightening the bolts. The buses shall lie freely on the insulators without warping and if necessary, suitable packing shall be provided at the insulators.

b. Final tightening of the bolts shall be done after the complete laying of buses. Approved means shall be used for tightening of the bolts.

c. Bimetallic strips/washers shall be used wherever aluminium busbars or aluminium cables are terminated on copper busbars.

**04.18.12 LIMIT SWITCHES**

The places of installation shall be seen from the engineering drawings and the switch shall be secured by means of adjustable bars. Any modifications required in positioning of limit switches as per site conditions shall be done by the tenderer.

**04.18.13 MISCELLANEOUS EQUIPMENT**

**04.18.13.01 CABLES INSTALLATIONS**

1) Cable shall be fixed to racks or trays or cleats as required for proper support, accessibility and neatness of installation. Cable tags shall be provided at a regular interval of 30M. For cable run shorter than 30M one cable tag shall be provided in the middle. These tags shall be in addition to end cable tags. The cable tags shall be marked with cable number, size and voltage grade. Middle tag shall be indicated with destination. The end tag shall be with second terminal point.

2) Cables shall be clamped rigidly at an interval of not more than 1500 mm in horizontal and 1000 mm in vertical & inclined run and at bends.

3) In the cable galleries, cable structures shall be properly arranged giving sufficient clearance for movement of personnel from one part of the gallery to the other. It shall also be possible to escape easily in case of fire.

4) Cables laid in over ground structures shall be protected from the direct solar radiation. Road crossing points sufficient clearance shall be provided with due consideration to road traffic. In outdoor structure cat ladder and walkable platform shall be provided to facilitate cable removal/addition on the cable trays.

5) Perforated trays shall only be used where necessary for the support of a number of small cables. Each tray shall be firmly supported at suitable intervals and shall carry the weight of its cables without sagging. Trays shall be painted and where the surfaces or edges are cut or otherwise impaired during erection, they shall be made good by coating with aluminium paint.

6) Small cables may be bunched together under one saddle provided that in any bunch all cables have sheaths of the same material. The number of cables shall not exceed four wide and two deep.
7) Not more than one cable shall be drawn into one conduit unless otherwise agreed. After the cable has been drawn in, the conduit shall be sealed by an approved means.
8) All cables shall be tested for proper insulation before start of laying work.
9) Cables shall be laid in conduits, racks/trays, cable trenches, along with structures or buildings, as per cable routing drawing and cable list.
10) Suitable adjustment shall be made in cable routes, if required at site, with a view to avoid any interference with any part of building, structures, equipment, utilities and services with the approval of the purchaser.
11) While laying cables, care shall be taken that kinks, twists or mechanical damage do not occur to the cable.
12) All bends in cables shall be made with due consideration to the minimum permissible bending radius of the cables.
13) On being pulled, the cable shall not be allowed to drag drawing along the ground or over a second cable already laid. Special care shall be taken while pulling through an opening where other cables have already been laid. Only approved cable pulling devices shall be used.
14) No joints shall normally be made at any intermediate point in through run of cables unless the length of the run is more than the standard drum length. In such cases where jointing is unavoidable, the same shall be made inside proper bases having plastic moulds and shall have moulded epoxy resin construction. Provision shall be made for earthing continuity at the joint. Cable splicing and jointing shall be done in accordance with the relevant IS code of practice and manufacturer's instructions. Insulation resistance of cables shall be checked before cable jointing.
15) Adequate length of cables shall be pulled inside the switch boards, control panels, control desks, etc. so as to permit neat termination.
16) All cables shall be neatly dressed without interlocking or cross overs. While laying the cable vertically, these shall be clamped at suitable intervals. Horizontal runs shall be rigidly secured to trays on racks/hangers in all the places where the direction of the route changes as well as at cable terminations or joints. The clamps shall not be done up so tight that the insulation is damaged or deformed.
17) Cable markers shall be provided on either side of road crossing at each turning and at 30 m intervals at straight runs for underground cables.

18) Where cables are required to cross roads, surface drains and water, oil, gas or other pipe lines, they shall be taken through reinforced spun concrete or steel pipes.
19) Entry of cables from underground to the buildings or trenches shall be through pipe sleeves. After laying of cables, the sleeves shall be sealed with bitumin or epoxy compound with sand matting and cement plaster to make them fully water tight.
20) Special consideration shall be given for protection of cables against chemical and mechanical damage.
21) All cable entry openings in the equipment shall be sealed with fire proof materials. All cable openings in walls and floors shall be sealed after laying of cables by water and fire proof materials.
22) All cables shall be provided with identification tags indicating the cable number in accordance with cable lists. Tags shall be fixed at both ends of the cable and at 30 m spacing for straight runs as well as on both sides wherever cables are crossing walls/floors. The tags shall be of aluminium/PVC with numbers punched/painted on them and securely attached to the cables by non-corrosive wires. The shape of tags shall be round, triangular and rectangular for control, medium voltage and high voltage cables respectively.
23) Glanding shall be done for direct entry of both power and control cables into the panels by the contractor. Double compression type brass cable glands shall be used.

24) The cables shall be terminated in accordance with relevant connection diagram. Termination and clamping shall be carried out in such a manner as to avoid strain on the terminals.
25) All power cable terminations shall be by means of crimping type cable lugs. For flexible conductors, soldered termination shall be adopted. In case of aluminium power cables termination on copper bus bars, suitable aluminium copper bimetallic washers shall be used. Corrosion inhibiting grease shall be used for aluminium cable terminations.

**04.18.13.02**

26) Suitable numbered and coloured letter interlocking type ferrules shall be provided for end termination of power and control cables.
27) Control cable entering switch boards, control panels, control desks etc. shall be neatly bunched and strapped with PVC perforated straps and suitably supported to keep it in position at the terminal blocks. All spare cores of each cable shall be segregated, marked spare, neatly dressed and suitably taped at both ends.
28) When the cores of two or more multicore cables take a common route, cores of each cable shall be separately bound and the separate bundles neatly bound together.

29) Individual cores of control cables shall have plastic interlocked type coloured ferrules with engraved numbers at both ends of the circuit for identification.
30) The contractor shall be responsible for correct phasing of motor power connections and shall interchange connections at the motor terminals box, if necessary, after each motor is test run.
31) The trays shall be earthed and rendered electrically continuous by welding the trays to the grounding strip at not less than two places from both sides of the tray.

**04.18.13.03 EXPOSED CONDUITS**

a) Exposed conduits shall be laid along walls, floors, ceilings, on steel supports etc. as per working drawings/site requirements in consultation with the supervisory personnel. The conduits shall be neatly run and evenly spaced.

b) Fixing of conduits to the supports on wall, column, structure shall not be done by welding. Exposed conduits shall be adequately supported by racks, clamps, straps etc.

c) Jointing of conduits shall be done only in straight portion and not in bend portion.

d) The contractor shall have available at site bending facilities for conduits as well as dies for threading conduits of diameters and threads corresponding to the standards. The threaded ends of conduits shall be painted with anticorrosive paint. The outer ends shall be smoothened free of burrs and sharp edges. Sealing shall be at both ends of conduits.

e) Flexible metallic conduits shall be used for termination of connections to motors and other electrical equipment like pressure switches etc. which need to be disconnected at periodic intervals.

f) All conduits shall be effectively connected to the earth terminal of the equipment where it terminates.

g) Both ends of conduits shall be suitable earthed. Earthing continuity to be maintained by means of flexible wire wherever two conduits are joined with sockets.

h) Approved conduit bending machines to be arranged by the contractor shall be used for bending conduits in the field. The radius of any conduit bend shall be as per standards for cabling. Bends shall be free from cracks, crimps or other damage to the pipe or its coating.

# 05.00 INSPECTION AND TESTING

## 05.01 INSPECTION

### 05.01.01 GENERAL

a) Manufacturing progress review, inspection & testing of equipment covered under the technical specification shall be carried out by the Purchaser at the manufacturers' works/premises prior to despatch to ensure that their quality & workmanship are in conformity with the contract specifications and approved drawings.

b) These instructions are in addition to provisions laid down in other tender documents of the Purchaser.

### 05.01.02 INSPECTION & TESTING STAGES AND FINALISATION OF QUALITY ASSURANCE PLAN (QAP)

a) Within 12 weeks of the award of contract the Contractor shall furnish the quality assurance plan as per proforma given to successful tenderer for electrical equipment. separately with suggestive stages and hold points for undertaking inspection and testing by the Purchaser/TANGEDCO. Total list of plant & equipment of the order shall be submitted to the Purchaser/TANGEDCO prior to submission of QAP

b) After receipt, scrutiny and rendering into acceptable mode of above documents, a mutually agreed programme of inspection & testing of equipment shall be finalised with the Contractor by the Purchaser/ TANGEDCO.

c) Inspection & testing of plant & equipment shall be undertaken by the Purchaser / TANGEDCO after finalisation & approval of QAP.

### 05.01.03 RESPONSIBILITY FOR INSPECTION

a) Any inspection by the Purchaser does not replace the responsibility of quality assurance and quality control functions, as expected of the Contractor to be performed by him for supply of plant & equipment as part of the contractual obligations. As such, any approval which the Inspecting Engineer of the Purchaser may have given in respect of plant and equipment and other particulars and the work or workmanship involved in the contract (whether with or without test carried out) shall not bind the Purchaser to accept the plant and equipment, should it on further test at site be found not to comply with the requirements of the contract.

b) The Contractor is to meet the inspection & testing requirements for the equipment coming under statutory regulations e.g. weights & measures, safety, IE rules, etc. and submit certificates and documents from appropriate authority to Inspecting Engineer for the same.

**05.01.04 EXTENT OF INSPECTION**

a) The extent of inspection by the Puchaser shall vary from equipment to equipment as per design requirements.

b) However, indicative extent of inspection for electrical equipment is furnished below.

c) Extent of inspection to be carried out shall be finalised with the Contractor after award of the contract on the basis of scope of supply, technical specification and approved GA drawings. However, in case of similar bulk manufactured items, methods of sampling for inspection of different lots shall be governed by relevant Indian or international standards.

d) In case of critical components, the Purchaser reserves the right to undertake 100% inspection.

**E) .CATEGORIES OF EQUIPMENT** :

1. Bought out items.&
2. Final Inspection & testing

**F).EXTENT OF INSPECTION :** (as applicable from equipment to equipment)

**i) BOUGHT-OUT ITEMS**

Following standard bought-out items shall be accepted on the basis of manufacturers' test certificates:

- LV current transformers
- Standard AC motors
- AC /DC DBs
- Push button station in manu-facturers' standard enclosure
- LT power, control & instrumentation cables and cable termination / jointing kits
- Starters in manufacturer's standard enclosure
- Light fittings
- Field instruments
- Conduits
- Cable trays

**ii) FINAL INSPECTION & TESTING:**

- Verification of test certificates
- Visual & Workmanship
- Dimensional

- Witnessing of routine tests as per relevant standards. Manufacturers' test certificates for type test to be submitted for verification.
- Witnessing of proto-type tests, as applicable

**05.01.05 TESTS, TEST CERTIFICATES AND DOCUMENTS**

a) For each of the items being manufactured, following test certificates and documents (as applicable for each of the equipment) in requisite copies shall be prepared and submitted to the Inspecting Engineer for scrutiny & records.

i) Materials identification & physical and chemical test certificates for all materials except IS:2062 -1992 and FG 150 IS:210-1978 materials used in manufacture of the equipment.

ii) Welding procedures and welder's qualification test certificates, wherever applicable.

iii) Routine/type/calibration/acceptance/special test certificates for electrical items.

iv) Surface preparation and painting certificates.

v) Certificates from competent authority for the items coming under statutory regulations.

b) The Contractor shall be required to produce the specimen and test pieces on which tests were carried-out by his sub-contractors and if called for, samples and specimen shall become the Purchaser's property.

c) Where facilities for testing do not exist in the Contractor/sub-contractor's laboratories or in case of any dispute, samples and test pieces shall be drawn by the contractor/sub-contractor in presence of Inspecting Engineer and sealed samples shall be sent to any approved laboratories for necessary tests at Contractor/sub-contractor's cost.

d) The Purchaser/TANGEDCO shall have the right to be present and witness all tests being carried out by the Contractor/sub-contractor at their own laboratory or approved laboratories. Also, the Purchaser/TANGEDCO shall reserve the right to call for confirmatory test on samples, at his discretion.

e) Should the result of tests not come within the margin specified, the tests shall, if required, be repeated at Contractor's cost without any liability to the Purchaser.

**05.01.06 METHOD OF GIVING INSPECTION CALLS**

Inspection calls shall be given by the Contractor. All calls shall accompany four sets of relevant test certificates and inspection report of the Contractor/ sub-contractor after satisfactory completion of internal inspection and tests by them as per approved QAP.

**05.01.07 OBLIGATIONS OF THE CONTRACTOR**

The Contractor shall provide all facilities and ensure full and free access of the Inspecting Engineer of the Purchaser to the Contractor's or their sub-contractor's premises at any time during contract period, to facilitate him to carryout inspection & testing of equipment during manufacture of equipment.

This clause shall be read along with Vol.I for further details.

Stamping and issue of inspection memo & certificate & waiver

**05.02 TESTING**

**05.02.01 GENERAL**

a) Test of all equipment shall be conducted as per latest IS. Tests shall also confirm to International Standards IEC/VDE/DIN/BS.
b) All routine tests shall be carried out at manufacturer's works in presence of purchaser or his representative.
c) The tenderer shall submit type test certificates for similar equipment supplied by him elsewhere. In case type test certificates for similar equipment is not available, the same shall be conducted in presence of purchaser or his representative if purchaser so desires, without any financial implications to purchaser. Heat run test based on type test certificate of similar transformer is acceptable.
d) The site tests and acceptance tests to be performed by contractor are detailed below.
e) The contractor shall be responsible for satisfactorily working of complete integrated system and guaranteed performance.

**05.02.02 SITE TESTS AND CHECKS**

**GENERAL**

a) All the equipments shall be tested at site to know their condition and to prove suitability for required performance.
b) The test indicated in following pages shall be conducted after installation. All tools, accessories and required instruments shall have to be arranged by contractor. Any other test which is considered necessary by the manufacturer of the equipment, contractor or mentioned in commissioning manual has to be conducted at site.
c) In addition to tests on individual equipment some tests/ checks are to be conducted / observed from overall system point of view. Such checks are highlighted under 'Miscellaneous tests' but these shall not be limited to as indicated and shall be finalised in consultation with TANGEDCO before charging of the system.
d) The contractor shall be responsible for satisfactory working of complete integrated system and guaranteed performance.

e) All checks and tests shall be conducted in the presence of TANGEDCO's representative and test results shall be submitted in six copies to TANGEDCO and one copy to Electrical Inspector. Test results shall be filled in proper proforma.
f) After clearance from Electrical Inspector system/ equipment shall be charged in step by step method.
g) Based on the test results clear cut observation shall be indicated by testing engineer with regard to suitability for charging of the equipment or reasons for not charging, are to be brought by the contractor.

**05.02.03 SITE TESTS**

The tests to be carried out on the equipment at pre-commissioning stage shall include following but not limited to the following:

**05.02.03.01 TRANSFORMER**

1. IR test on each winding to ground and between windings.
2. Turns ratio test on each tap
3. Polarity and vector group test
4. Measurement of winding resistance
5. IR, wiring and operational tests on all control devices in control cabinet, oil level indicator, winding and oil temp. indicators, cooling fan etc.
6. Checking of earthing with respect to transformer tank (flexible from top cover to tank) other parts, neutrals and tank to electrodes of LAs (for LAs located near to transformer)
7. Testing of buchholz relay for alarm and trip conditions.
8. For bushing CTs, tests applicable shall be as for current transformers.
9. Setting of oil/winding temperature indicators, level gauge and checking of alarm/trip circuits.
10. Check insulators for cracks.
11. Checking for oil leakage and arresting of leakages (if there)
12. Checking of operation of all valves.
13. Checking for open position of all the valves (except drain and filter valves)
14. Filtration of oil by using line filter, vacuum pump, and heater set.
15. BDV test on oil samples from top and bottom.
16. Checking of oil for acidity, water content, tan delta etc. as per IS 335.
17. Measurement of magnetising current and no load loss.
18. Measurement of PI value.
19. Checking of silica gel breather.
20. Checking of noise level at no load and at full load.
21. Checking of air circulation conditions for indoor transformers.
22. Conducting magnetic balance test
23. Checking of other points given in manufacturer's commissioning manual.
24. Back charging of the transformer and checking of voltages at different tap positions.
25. Tan delta Test and SFRA test at site

**5.02.03.02 CURRENT TRANSFORMER**

1. IR test on each winding, winding to earth and between windings.
2. Checking of winding ratios by primary injection set.
3. Polarity check on each winding.
4. Continuity check for all windings.
5. Check for connections to correct taps.
6. Measurement of knee point voltage and secondary winding resistance for the CTs used for differential protection.
7. Checking of continuity and IR values for cables from CT to Marshalling box.
8. Checking tightness of earthing connections.
9. Check output after loading of the main circuit.
10. Tan Delta Test

**5.02.03.03 POTENTIAL TRANSFORMER**

1. IR test of primary winding by HV megger between windings and earth
2. IR test of secondary winding by LV megger between windings and winding to earth
3. Checking of voltage ratio
4. Verification of terminal markings and polarity
5. Checking of continuity and IR values for cables from PT to Marshalling Box
6. Checking tightness of earthing connections
7. Checking of insulator for cracks
8. Check output on charging of the system with connected meters/relays
9. Tan Delta Test

**5.02.03.04 ISOLATOR / DISCONNECTING SWITCHES**

1. IR test by HV meggar on main poles
2. IR test on control circuits
3. Measurement of Contact resistance for all three phases
4. Functional checking for electrical and manual operation
5. Checking of interlocking with earth switch and as per write up and checking of earth switch operation.
6. Checking of operation of earth switch.
7. Setting and checking of auto trip operation of motor on complete close / open position of isolator.
8. Testing of overload relay of motor
9. Checking for remote operation
10. Checking of operation on minimum and maximum specified voltages (local as well as remote)
11. Checking tightness of earthing connections
12. Checking of insulators for cracks

**05.02.03.05 LIGHTNING ARRESTOR**

1. Continuity check (for metal oxide type only)
2. Check for connection to ground

3. Check insulators for cracks
4. Check reading of leakage current
5. HT and IR test of each element

**05.02.03.06 INSULATORS**

1. Checking of tightness of connection
2. Check for minor damage / cracks after cleaning
3. Verification of number of disks as per drawing
4. Check for creepage distance on one type of each set
5. Check heating at termination point during shutdown

**05.02.03.07 NGT**

1. Measurement of resistance
2. IR test by HV megger between terminal and earth.
3. Checking of earth connection for terminal and for body
4. Check for isolator operation and continuity of aux. contacts (if applicable)
5. Check for temp. rise of enclosure and current flow in the resistances.

**5.02.03.08 LT SWITCHGEAR**

1. IR test
2. HV test with 1.1 kV meggar
3. Functional test for all feeders
4. Testing of all meters
5. Checking and calibration of overload relays and protective relays as per supplier's commissioning manuals.
6. Check operation of contactors from local and remote points
7. Checking of interlocking between incomers/bus coupler and other feeders.
8. Test to prove interchangeability of similar parts

**05.02.03.09 PDB/DCDB**

1. IR test before and after HT test
2. HV test by 1.1 kV megger
3. Checking for functions of components for each module
4. Checking for interchangeability of similar components
5. Checking of tightness of earth connection.
6. Testing and calibration of all indicating meters
7. Check output of each feeder after energisation.

**05.02.03.10 AC MOTORS**

1. IR test of stator and rotor windings.
2. Check tightness of cable connection
3. Winding resistance measurement of stator and rotor.
4. Check tightness of earth connections.
5. Check space heaters and carryout heating of winding (if required)
6. Check direction of rotation in decoupled condition during kick start
7. Measure no load current for all phases.

8. Measurement of temperature of body during no load and load conditions.
9. Check for tripping of motor from local/remote switches and from electrical/ technological protection including differential protection.
10. Checking of vibration.
11. Checking of noise level.
12. During load running, measurement of stator and bearing temperatures (if applicable) for every half an hour interval till saturation comes.
13. Checking tightness of foundation bolts
14. Check continuity of temp. detectors.
15. For actuator drives following shall be checked/tested :

- Visual and dimensional
- IR and operation of limit switches
- Winding resistance

**05.02.03.11 UNINTERRUPTED POWER SUPPLY**

1. Visual check
2. IR value by megger
3. Current limit test
4. Ripple test
5. Supply variation
6. Functional test
7. Capacity test with respect to time

**05.02.03.12 CABLES & CABLES SUPPORTING STRUCTURES**

1. Checking of continuity/phasing and IR values for all the cables before and after HV test.
2. HV test and measurement of leakage current after termination of cable kits (for HT cables).
3. Checking of earth continuity for armour and fourth core (if applicable).
4. Check for mechanical protection of cables.
5. Check for identification (tag number system) distance placement of cable marker, cable joint etc. as per the cable layout drawing.
6. Check earthing of cable structures.
7. Check clearances from ventilation duct and light fittings for cable structures.
8. Check proper fixing of cable structures.

**05.02.03.13 INDOOR LIGHTING**

1. Check dressing of cable
2. Measurement of lux level at various places
3. Check accessibility for replacement of lamps
4. Checking for black spots or poor visibility near operating and indicating equipments
5. Check for mechanical protection of cables
6. Checking for adequacy of emergency DC light
7. Checking for starting system of periphery lighting
8. Check for auto switching of battery supply on failure of AC

9. Checking of earthing of light panel, socket boards, light fittings
10. Checking of type of fittings with respect to specification at various locations
11. Check adequacy of support of fittings
12. Check water tightness of outdoor located panels

**05.02.03.14 EARTHING**

1. Check tightness of all earth connections
2. Check earthing of all metallic equipments, cable trays, busbar supporting structures, yard fencing steel structures of yard, rails, gates, building column (if steel) all elect. equipments, gas/oil/water pipe lines etc. as per the drawing / specification
3. Measurement of earth resistance for each electrode.
4. Measurement of total earth resistance.
5. Measurement of earth loop resistance for E/F path of biggest LT drive.

**05.02.03.14 CONTROL, RELAY & METERING PANELS**

1. IR value test by megger
2. Checking of control cable connection.
3. Operational test of all components mounted on control panel.
4. Testing and calibration of indicating meters
5. Testing of all relays including auxiliary relays for their pick up- drop values, operation at all taps (current, voltage and time) etc. as per the manufacturer's commissioning manuals with the help of relay testing kits.
6. Setting of relays as per approved setting table and checking its operation for one below and one upper settings, in the scheme.
7. Measurement of current and voltage in relay operating coils by secondary injection in CT and PT circuit at switchboard.
8. Measurement of current and voltage in relay and meter circuits during loading of the primary circuit/system
9. Testing of all schemes for their functions as per approved drawings
10. Checking stability of differential protection schemes
11. Checking inter changeability of similar equipments
12. Verification of accessibility of all operating points including resetting knob of relays
13. Check operation of each annunciation facias, operation of bell/hooter etc. and sequence of the system
14. Check operation of relays at minimum/maximum control voltage as per the specification
15. Integrated testing of protective relays for operation of master trip relays and tripping of breakers from Operation of master trip relay
16. Check dressing of cables, sealing of openings in gland plate and for provision of double compression glands
17. Check earthing connection of panels, fixing of panels and openings from side and bottom.
18. Checking and adjustment in tri-vector meters as per the manufacturer's instructions.

**05.02.03.15 MISCELLANEOUS**

1. Checking of continuity of the system
2. Checking of phase sequence from overhead line to consumer end
3. Checking safe accessibility of all operating points
4. Check availability of emergency lighting
5. Check availability of control/aux. supply
6. Ensure availability of first aid box, fire fighting equipments, earth discharge rods, rubber mats, rubber glove
7. Check working of ventilation system for battery room - transformer room etc.
8. Check proper covering of cable channels.
9. Placement of shock treatment chart, danger boards, provision of boards indicating 'Man on Work, Do not switch ON', 'Do not switch OFF', 'Earthed', etc.
10. Check proper dressing of cables, mechanical protection of cables, placement of cable markers
11. Check sealing of all cable openings including conduit opening with fire resistance material
12. Check sealing of all openings at bottom of elect. panels.

## 06. LIST OF PREFERED MAKES

TRANSFORMERS

| | |
|---|---|
| GENERATOR TRANSFORMER | CGL/BHEL /KEC / TR / EMCO / ALSTOM |
| LT Transformer | BHEL/CGL/GEC ALSTHOM/ VOLTAMP/EMCO |
| 110 kV ISOLATOR | S&S, ELPRO INTERNATIONAL, HIVELM, GR POWER, Hyderabad |
| 110kV CURRENT TRANSFORMER | AE / ABB / AREVA / CGLI / GEC |
| 110kV POTENTIAL TRANSFORMER | AE / ABB / AREVA / CGLI / GEC |
| 110 kV LIGHTNING ARRESTOR | ELPRO INTERNATIONAL LIMITED / W.S INDUSTRIES LTD / OBLUM INDUSTRIES LTD |
| HV BUSDUCT | ECC (KOLKATA)/ STAR DRIVE NOW KGS ENGINEERING LIMITED(CHENNAI)/ ENPRO (CHENNAI)/ BEST & CROMPTON/ SIEMENS/ BHEL/ CONTROL & SWITCHGEAR |
| 11kV /LT CURRENT TRANSFORMER | AE /ABB/ JYOTI / KAPPA / WSI/INDCOIL |
| 11kV POTENTIAL TRANSFORMER | AE /ABB/ JYOTI / KAPPA / WSI / INDCOIL |
| 415V SWITCHGEAR | LARSEN &TOUBRO LTD (ECC GROUP) / SIEMENS LTD / ASIA BROWN BOVERI LTD /GEC (ALSTHOM) |
| MOTOR CONTROL CENTRES | SIEMENS LTD / ASIA BROWN BOVERI LTD /KIRLOSKAR ELECTRIC COMPANY LTD / GEC ALSTHOM INDIA LTD |
| LT AIR CIRCUIT BREAKER, | SIEMENS/ BCH/GE(ALSTHOM)/ L&T/ C&S/ SCHNEIDER |
| UPS | SIIEMENS / HIREL / EMERSON/GE / DB POWER CONTROL |

| | |
|---|---|
| SOLID STATE ANNUNCIATOR | APLAB/ L&T/ ELECMECH/PROCON/ MINILEC/ CONTROL-AND DYNAMICS |
| NUMERICAL PROTECTION RELAYS | SIEMENS/ ABB/ AREVA FOR LT SYSTE SCHNEIDER/ L&T(MM30)/ ASIDA |
| NUMERICAL PROTECTION RELAYS | AREVA / SIEMENS / ABB / L&T FOR HT SYSTEM |
| AUXILIARY RELAYS | AREVA/ EASUN/ ABB/ L&T/ GE/ SCHNEIDER/ SIEMENS/ BCH/ ROCKWELL |
| AMMETER/ VOLTMETER | AEP/ IMP/ MECO AE/GEC// L&T WATTMETER/ VAR-METER |
| VOLTAGE/ POWER/ CURRENT TRANSDUCER | /ABB/AEP/ EMENS/FREQUENCY/ENERGY ELSTER / ADEPT |
| MOULDED CASE CKT BREAKER | SIEMENS/ GE POWER/ L&T/ABB/ SCHNEIDER/ BCH/ ANDE-RW YULE |
| INDICATING LAMP<br>LED TYPE) BINAY/ J-AUER | SIEMENS/ VAISHNO/ TECHNIK/LUSTER |
| HOOTER/ BUZZER/ BELL | GETCO/ KHERAJ/ EDISON/KAKKU |
| HT CABLES | RPG/ CABLE CORPORATION OF INDIA LTD/ FORT GLOSTER INDUSTRIES (T) HOWRAH / ASIAN CABLES & INDUSTRIES LTD |
| LT CABLES | RPG/ CABLE CORPORATION OF INDIA LTD/ FORT GLOSTER INDUSTRIES (T) HOWRAH / ASIAN CABLES & INDUSTRIES LTD |
| CONTROL CABLE | RPG/ CABLE CORPORATION OF INDIA LTD/ FORT GLOSTER INDUSTRIES (T) HOWRAH / ASIAN CABLES & INDUSTRIES LTD |
| LOCAL PUSH BUTTON STATIONS | SIEMENS/ L&T/ BCH/ BHEL/ C&S/ TECHNOCRAT/ B&C/ MEDITRON/ ELECTRO FABRIC/ HCE/ SEN & SINGH |

| | |
|---|---|
| | /TECHNO COMMERCE/ SWITCHING CIRCUIT/ VIJAY SWITCHGEAR |
| LIGHTING FITTINGS | PHILIPS/GE/ BAJAJ/(SV/MV/MH/FLUROESCENT/CFL) CGL/ WIPRO/ FLOROCRAFT |
| HT CABLE JOINTING KITS & TERMINATION KITS | RAYCHEM/ 3M/ DENSONS// M – SEAL |
| CONTACTORS | SIEMENS / ALSTHOM / L&T / CGL / SCHINDIR/BCH/ABB |
| HT HRC FUSES | AREVA/ DP/ S&S/ COPPER- BUSSMAN |
| TEMPERATURE SCANNER | JYOTI / APLAB/SYNTECH / MASIBUS |
| MCCB | SCHNEIDER (MG)/ L&T/ ABB/SIEMENS/ GE POWER CONTROL / CONTROL & SWITCHGEAR/ BCH /MDS( LEGRAND |
| MINIATURE CIRCUIT BREAKER | SIEMENS/ L&T/ GE POWER CONTROL/SCHNEIDER (PROTEC / MG)/ STANDARD/INDOASIAN/ HAVELLS/ MDS (LEGRAND)/ ABB |
| MOTORS | SIEMENS LTD / ASIA BROWN BOVERI LTD/ / KIRLOSKAR ELECTRIC COMPANY LTD / GEC ALSTHOM INDIA LTD |
| TERMINAL BLOCK | EPCC/ ELMEX/ PHOENIX CONTACT/ CONNECT WELL/ ESSEN DEINKI/ WAGO/LAPP/ S&S/ HANSEL |
| MIMIC PANELS & ANNUNCIATION PANELS | L&T / ADVANI OERLIKON / GE POWER CONTROL/ BHEL/ BCH/ TRANSRECT/ MINLEC/ TIRUPATI ELECTRONICS/ ADVANCE POWER CONTOL/ CONTROL DEVICES |
| ACSR CONDUCTOR | APAR, MUMBAI, SMITA CONDUCTORS, DEEPAK CABLES, GUPTA CONDUCTORS, ALIND CORPORATION |

07. **LIST OF SPECIFICATION DRAWINGS**

For specification drawings refer Volume IV.

## 08. DRAWINGS/ DOCUMENT TO BE SUBMITTED BY THE TENDERER

### 08.01 DRAWINGS/ DATA ALONG WITH TENDER

1. Scope of work with general description of the system and equipment offered specifying the important features.
   The description to be accompanied by single line diagrams, and equipment layout to enable the Purchaser to have a proper appreciation of the equipment offered and its operation.
2. Electrical layout of Control Room and main plant indicating location of all equipment / panels
3. Construction/ Erection Plan.
4. Technical catalogues of equipment offered.
5. Phase-wise requirements of power for construction, erection/testing activities.
6. Any other information tenderer feels to submit to understand the quotation in complete.

Note : **FAILURE TO COMPLY WITH ABOVE MAY BE ITSELF SUFFICIENT REASON TO REJECT THE OFFER**.

### 08.02 DATA/ DRAWINGS TO BE SUBMITTED BY SUPPLIER AFTER PLACEMENT OF ORDER

#### 08.02.01 GENERAL

a) Name of coordinators with address, telephone/FAX numbers for all sub-contractors, pertaining to electrical job.
b) List of equipment/tools and manpower proposed to be arranged for installation erection and site handling of the equipment.
c) Name of site in-charge with office/ organisation and date of opening of site office.
d) Quality control manuals
e) Detailed list of drawings and documents containing information on current state of the project.
f) Monthly progress report furnishing status of

- Planning
- Manufacture
- Transport
- Erection
- Testing & commissioning

#### 08.02.02 FOR APPROVAL

**A. CALCULATIONS**

1. Relay settings with calculations and graph for justification of all relay settings (current, voltage and time).
2. Calculation to justify generator CT/PT parameters like VA burden, knee point voltage etc. for all cores.
3. Calculations for Required battery capacities of the UPS system.

4. Calculations for voltage drop and short time rating of cables to prove adequacy of sizes.
5. Calculation for Neutral grounding transformer and secondary resistance.
6. Calculation of lux levels of Control Room, Machine hall and other floors
7. Calculations for short time withstand of transformers.
8. Calculations for design of supporting structures for outdoor switchyard regarding wind pressure, short circuit forces etc.

**B. OTHERS**

1. Single line diagram indicating transformers, breaker, CT/PT, all relays, meters, LA, cable sizes, details of CT/PT ratio, VA burden, Vk value, type and make of all relays, their range, nominal and short time ratings of busbars, etc. for all equipment.
2. Front view and GA diagrams for all panels.
3. Control and schematics drawings for local/remote control/protection for each equipment and drives.
4. Drive list.
5. Synchronisation schemes.
6. Auto change over arrangement
7. Logic diagrams for start/stop of various mechanism/drives
8. Lighting layout for Control Room and other areas. Type of fittings, wiring arrangement, switching of fittings and single line diagram from board to fittings.
9. Details of protection logic (class A,B&C tripping) indicating list of electrical and mechanical protection leading to tripping of turbine generator, field breaker, etc.
10. Equipment Earthing layout drawing
11. Electrical equipment layout for all electrical premises.
12. Cable structure layouts with size of structures for gallery and cable channels of different places
13. Sequence of inspection plan and despatch of materials to site.
14. List of drawings, numbering system, size, proposed date of submission (To be submitted just after LOI).
15. Installation drawings of all equipment with

- Layout of equipment
- Layout of Cabling
- Illumination drawings
- Earthing Layout.

**08.02.03 FOR INFORMATION**

1. Details of painting for all equipment
2. Bus wire arrangement for control/signal/annunciation and heater supplies of control panels and switch boards.
3. Cable schedule indicating type of cables, from to via. route, total length, size of each cable and a final summary sheet indicating total requirement of all types of cables (for control and power both).

4. Core wise control cable termination details indicating ferrule no./terminal block no. for each cable/each equipment.
5 Internal wiring diagrams for all panels.
6. VI characteristics and RCT values of CTs used in differential protection.
7. Cable layout drawings.
8. Technical particulars of all LT motors and recommended protection.
9. Catalogues for each type of equipment, relays, meters etc.
10. Installation and commissioning manuals for each equipment, relay etc.
11. Operation and maintenance manuals indicating trouble shooting procedure for all equipment.
12. Type test certificates for all the major equipment.
13. Details of test results conducted at works for all equipment in bound Volume
14. Details of test results conducted at site for all equipment in bound Volume
15. Spare part list number and ordering procedure for all recommended spares.
16. Details of transport arrangement and maximum size of transportable section (weight and overall dimensions).
17. Details of agency proposed to be fixed for doing erection commissioning job.
18. Panel wise bill of material indicating type make and brief technical particulars of all items/ accessories mounted on the panels.
19. Overall GA of all the panels/equipment
20. Fixing details of all the panels/equipment, supporting structures, etc.
21. Heat loss for each equipment.
22. Static and dynamic loading of each equipment
23 Floor cutouts and wall opening details for cables bus duct, air conditioning ducts, light conduits, exhaust fans etc.
24. Details and location of various inserts base plates, bolts etc. required to be provided for support of cable structure, bus duct electrical panel, etc.
25. Conduit layout drawing indicating type, size, length and locations of conduits required to be placed in RCC wall/floor, brick wall.
26. Technical data sheet for each type of motors and characteristic curves for protection settings.
27. As built drawings incorporating site changes alongwith soft copies in CD.

# 09. TECHNICAL PARTICULARS TO BE SUBMITTED BY THE TENDERER

## 09.01 GENERAL

1. Instructions

The data called for below is to be furnished by the bidder and in case the bidder becomes the supplier, the data shall form part of the contract covering the work. The performance figures quoted shall be guaranteed within the tolerances permitted in the relevant standards.

2. Bidder's Name (For Electrics)
   1. Trade Name of Bidder :
   2. Address for correspondence :

3. General conditions

| | |
|---|---|
| Is it the Bidder's intention, if awarded the contract, to comply fully and in all respects with the Owner's specification? | Yes/No |
| If 'No', the bidder shall state the exceptions in details, clause-wise | |

4. Tenderer to submit all data/ information / drawings / spare part list pertaining to electrics, generator, static excitation & AVR system in one volume. — Agreed

5. Tenderer visited the site and understood the job & location of various equipments — Yes

## 09.02 DESIGN CONSIDERATIONS

| | | | |
|---|---|---|---|
| 1.0 | Loading (unit wise) | : | |
| 1.1 | Cold start up | : | |
| 1.2 | Hot start up | : | |
| 1.3 | Full Auxiliary load on one unit | : | |
| 2.0 | Battery capacity required (for the equipment/system of tenderer's scope) | : | Number AH |
| 3.0 | Any other aux. supply required (other than 415 V AC & 220 DC) | : | Indicate with purpose. |
| 4.0 | List of drives/mechanism with kW needs DC power supply | : | List to be enclosed |

**Spares and tools & tackles**

| | | | |
|---|---|---|---|
| 1. | List of commissioning spares | : | List to be submitted |
| 2. | List of special tools and tackles | : | List to be submitted |

## SUMMARY OF TECHNICAL PARAMETERS OF MAJOR ELECTRICAL EQUIPMENT

| Sl. No. | Equipment Description & Qty. | Make & type Country of manufacture | Total Weight. | Single largest package dimensions & wt. | Applicable std. | Rating as per design conditions of tender | Guaranteed tech. Data |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**09.03 SWITCHYARD EQUIPMENT**

**09.03.01 BUSHINGS/ SUPPORT INSULATOR**

1. Rated Voltage :
2. Impulse withstand voltage :
3. Power frequency withstand voltage :
4. Creepage :
5. Pollution level as per IEC 71 :
6. Insulators shall also meet the requirement Of IEC-815 having alternating sheds with creepage factor less than or equal to four (4). :

**09.03.02 110 kV ISOLATOR**

1. Type :
2. Service :
3. Pole :
4. Rated voltage :
5. Rated Frequency :
6. System Neutral Earthing :
7. Insulation Level :

7.1 Impulse Withstand Voltage :
7.1a To Earth & Between Poles :
7.1b Across isolating distance :
7.2 One Minutes Power Frequency withstand Voltage :
7.2a To Earth & Between Poles :
7.2b Across isolating distance :

8. Rated Current :

8.1 Continuous at 50`C ambient :
8.2 Short time current for 3 Secs :
8.3 Peak Short time current :

9. Creepage distance :
10. Operating Mechanism :

**09.07 LT SWITCHGEAR, AC DISTRIBUTION BOARDS, DC DISTRIBUTION BOARDS, DC STARTER PANEL & RESISTORS AND LOCAL AC STARTERS**

NOTE : Tenderer to furnish the following data separately for each of the above equipments.

**EQUIPMENT ASSEMBLY**

- Make:
- Type:
- Reference Standard:
- Short Circuit Rating:

a. Interrupting Symmetrical KA rms.
b. Short-time for 1 Sec. KA rms.

- Metal construction enclosed? : Yes/No
- Degree of Protection:
- Thickness of sheet metal:
  a. Front
  b. Back
  c. Side
  d. Bottom/Top
- Dimensions of vertical section in mm (LxDxH)

**CONSTRUCTION:**

- Draw out features provided for:

  a. Circuit breaker with Service, Test & Isolated position Yes/No :
  b. Voltage Transformers Yes/No :
  c. Protective Relays Yes/No :
  d. MCC modules Yes/No :

- All meter, switch and relays flush mounted type Yes/No :

**-CIRCUIT BREAKER**

- Make:
- Continuous current rating
  a. As per manufacturer's standard:
  b. Derated factor (if any) for site condition
- Symmetrical interrupting capacity(MVA) :
- Making current (peak), KA :
- Rated 1 second current, KA (rms) :

- Whether drawout, semi-drawout, or non-drawout type ? :
- Closing mechanism
  a. Type:
  b. Rated voltage of coil:
  c. Emergency closing mechanism provided?:
- Rating of motor used in breaker closing mechanism
- Shunt trip coil
  a. Type :
  b. Rated voltage of shunt trip coil
- Total opening time (measured from trip coil energisation) cyc/m.sec :

**09.08. MOTORS**

**LT MOTORS (AC)**

1. Make and type, reference standard :
2. Class of insulation :
3. Enclosure class :
4. Frame size :
5. Temp. rise over max. site ambient :
   for winding
   for enclosure
6. Min. volt to start :
7. Whether all motors are from one make
8. Type of protections envisaged : Electrical/Technological
9. Deviations if any on technical design data :

**09.09 CABLES (HT/LT Power control cables)**

The bidder shall indicate the following for each type and size of cables:

1. Make :
2. Type :
3. Shielding on Conductor (H.T. Cables)
   a. Material :
   b. Type :
   c. Thickness, mm :
   d. Whether extruded : Yes/No
4. Insulation
   a. Material :
   b. Type :
   c. Thickness, mm :

**Cable Termination kit**

| | XLPE cable | PVC cable |
|---|---|---|
| Make | | : |
| Type | | : |
| Complete with all accessories ? | | : |

**09.10 UPS SYSTEM:**

Make :
Capacity :
Overload :
Capacity of convertor :
Overload capacity of Invertor :

Battery

Make :
Type
AH Capacity
Harmonics at rated load
- with battery :
- without battery :

Overall dimensions of the panels :
Schematic diagram (to be enclosed)

# ANNEXURE-I

## SELECTION OF POWER COMPONENTS & WIRING FOR CONTINUOUS DUTY CAGE MOTOR DRIVES

| Motor Rating at S1 Duty (KW) | Minimum Rating of MCCB * | Minimum rating of Contractor (AMPS) AC3 duty | Minimum size for internal power connections | | Minimum size power cable (Copper) termination (sq. mm) |
|---|---|---|---|---|---|
| | | | Copper wire (mm2) | Aluminum Flat ** ( mm x mm) | |
| Up to 3.7 | | 25 | 4 | | 4 x 2.5 (Copper) |
| 5.5 | 100 | 40 | 4 | | 4 x 2.5 (Copper) |
| 7.5 | 100 | 40 | 6 | | 3 x 6 |
| 11 | 100 | 40 | 6 | | 3 x 16 |
| 15 | 100 | 63 | 10 | | 3 x 16 |
| 18.5 | 100 | 63 | 16 | 12 x 2 | 3 x 35 |
| 22 | 100 | | | | |
| 30 | 100 | 100 | 25 | 12 x 2 | 3 x 35 |
| 37 | 100 | 100 | 35 | 15 x 3 | 3 x 70 |
| 45 | 200 | 160 | 50 | 15 x 3 | 3 x 70 |
| 55 | 200 | 160 | 70 | 20 x 3 | 3 x 95 |
| 75 | 200 | 200 | 95 | 20 x 5 | 3 x 150 |
| 90 | 400 | 400 | - | 20 x 5 | 3 x 150 |
| 100 | 400 | 400 | - | 30 x 5 | 2(3 x 95) |
| 125/135 | 400 | 400 | - | 40 x 5 | 2(3 x 95) |
| 160 | 400 | 400 | - | 40 x 5 | 2(3 x 150) |

* MCCB rating shall be finalised in consultation with manufacturer of MCCB to achieve type `2' protection.

** Copper flat of equivalent size can be used instead of aluminium flat

Number of cores on cables shall depend on earthing system.

**SECTION IA**

**ANNEXURES**

## ANNEXURE-I

## MAKES OF SUB-VENDOR ITEMS

1. Bought out items listed in the Customer's specification HE-2367 shall be followed for make of various items to be replaced. In case of vendors or items not appearing in the preferred makes list, prior approval from M/s TANGEDCO shall be sought by furnishing the credentials of the vendors before proceeding.

2.The items / makes indicated below but not covered at "Annexure I, Volume: II-A, Section: VI , Project Management and Site Services" of Customer's Specification for makes as proposed by bidder shall be put up for Customer's approval during detailed engineering stage without any commercial & delivery implication to BHEL.

3.Bidder to propose sub vendor within 4 weeks of placement of LOI, thereafter no request for additional sub-vendor shall be entertained.

4.The inspection category will be finalized after award of contract during detailed engineering. Same will be adhered by the bidder without any commercial and delivery implication to BHEL

| SR. NO. | ITEM | SUPPLIERS | PLACE | REMARKS |
|---|---|---|---|---|
| 1. | STEEL | SAIL | | |
| | | TISCO | | |
| | | JINDAL | | |
| | | ESSAR | | |
| 2. | HOOKS | STEEL FORGING & ENGG. CO., | KOLKATA | |
| | | SIMRITI FORGING | | |
| | | KARACHIWALA | | UP TO 25T CAPACITY |
| 3. | GEAR COUPLINGS | ALLIANCE | | |
| | | FLEX-TRANS (formerly known as HICLIFF) | | |
| | | SAHARA | | |
| | | NUTECH | | |
| | | OEM | | |
| 4. | WIRE ROPE | USHA MARTIN | | |
| | | FORT WILLIAMS | | |
| | | BHARAT WIRE ROPES | | |
| 5. | BEARINGS | SKF | | |
| | | FAG | | |
| | | TATA | | |
| | | NBC | | |
| 6. | MOTORS | SIEMENS | | |
| | | NGEF (up to 15KW) | | |
| | | CROMPTON GEAVES | | |
| | | KIRLOSKAR ELECTRIC CO LTD. | | |
| | | BHARAT BIJLI | | |
| | | MARATHON | | |

| SR. NO. | ITEM | SUPPLIERS | PLACE | REMARKS |
|---|---|---|---|---|
| | | ABB | | |
| | | GE-POWER | CHENNAI | (FOR LT MOTORS ONLY) |
| | | LAXMI HYDRAULICS PVT. LTD | SOLAPUR-MAHARASHTRA | (FOR LT MOTORS ONLY) |
| | | RAJINDRA ELECT INDUSTRIES | | (FOR LT MOTORS ONLY) |
| 7. | BRAKES | ELECTROMAG | | |
| | | SPEED-O- CONTROL | | |
| | | BCH | | FOR DCEM BRAKES ONLY |
| | | KAKKU | | |
| | | PATHE | | |
| 8. | CONTACTOR | SIEMENS | | |
| | | L&T | | |
| | | SCHNEIDER (Earlier TELE MECHANIQUE) | | |
| | | BCH | | |
| 9. | OVER LOAD RELAYS | SIEMENS | | |
| | | L&T | | |
| | | ABB | | |
| | | SCHNEIDER (Earlier TELE MACHANIQUE) | | |
| 10. | HRC FUSES | SIEMENS | | |
| | | L&T | | |
| | | ENGLISH ELECTRIC | | |
| | | GE POWER | | |
| | | EATON (BUSSMANN) | | |
| | | ABB | | |
| 11. | ISOLATING SWITCH | SIEMENS | | |
| | | L&T | | |
| | | CONTROL & SWITCH GEAR | | |
| | | ABB | | |
| 12. | SWITCH FUSE UNITS | SIEMENS | | |
| | | L&T | | |
| | | CONTROL & SWITCH GEAR | - | |
| | | ABB | | |
| 13. | TIME DELAY RELAYS | SIEMENS | | |
| | | L&T | | |
| | | ABB | | |
| | | BCH | | |
| | | SCHNEIDER (Earlier TELE MACHANIQUE ) | | |
| 14. | TRANSFORMERS | INDCOIL | | |

| SR. NO. | ITEM | SUPPLIERS | PLACE | REMARKS |
|---|---|---|---|---|
| | | LOGICSTAT | | |
| | | KAPPA | | |
| | | AUTOMATIC ELECTRIC | | |
| | | PRECISE ELECTRICALS | | |
| | | SILKAAN ELECTRIC MFG. CO. LTD. | | |
| | | SOUTHERN ELECTRIC | | |
| | | NEC | | |
| 15. | BULB & FLOURESCENT TUBES/FITTINGS | PHILIPS | | |
| | | BAJAJ | | |
| | | CROMPTON | | |
| 16. | CABLE LUGS (HEAVY DUTY) | DOWELLS | | |
| | | UML ENGINEERS | KOLKATA | |
| | | JAINSON | | |
| 17. | HOOTERS | BEACON | | |
| | | OSC | | |
| | | TARGET | | |
| | | KHERAJ | | |
| 18. | LIGHTING SWITCHES | ANCHOR | | |
| | | ELLORA | | |
| | | BAJAJ | | |
| | | PHILIPS | | |
| 19. | PVC POWER CABLES | APAR INDUSTRIES LTD. | MUMBAI | |
| | | CORDS CABLE INDUSTRIES LTD. | NEW DELHI | |
| | | DIAMOND POWER INFRASTRUCTURE LTD | VADODARA | |
| | | GOYOLENE FIBRES (INDIA) PVT.LTD | MUMBAI | |
| | | GOVIND CABLE INDUSTRIES | KOLKATA | |
| | | GUPTA POWER INFRASTRUCTURE LIMITED | BHUBNESWAR | |
| | | HAVELLS INDIA LIMITED | NOIDA | |
| | | KEI INDUSTRIES LTD. | NEW DELHI | |
| | | KRISHNA ELECTRICAL INDUSTRIES LTD | GWALIOR | |
| | | KEC INTERNATIONAL LIMITED | MUMBAI | |
| | | MANSFIELD CABLES COMPANY LTD. | NOIDA | |
| | | NICCO CORPORATION LTD. | KOLKATA | |
| | | PARAMOUNT COMMUNICATIONS | NEW DELHI | |

| SR. NO. | ITEM | SUPPLIERS | PLACE | REMARKS |
|---|---|---|---|---|
| | | LTD. | | |
| | | POLYCAB WIRES PVT. LTD. | MUMBAI | |
| | | RADIANT CORPORATION PRIVATE LIMITED | HYDERABAD | |
| | | RAVIN CABLES LIMITED | MUMBAI | |
| | | SUYOG ELECTRICALS LTD. | VADODARA | |
| | | SRIRAM CABLES PVT. LTD. | NEW DELHI | |
| | | SCOT INNOVATION WIRES AND CABLES PVT. LTD. | SOLAN | |
| | | SAM CABLES & CONDUCTORS (P) LTD | UDHAM SINGH NAGAR | |
| | | THERMO CABLES LTD | HYDERABAD | |
| | | M/s Lapp | | |
| | | M/s Furukawa | | |
| | | M/s Torrent | | |
| | | M/s Universal | | |
| | | M/s RPG | | |
| 20. | PVC CONTROL CABLES | ADVANCE CABLE TECHNOLOGIES (P) LTD | BANGALORE | |
| | | APAR INDUSTRIES LTD., CMI LTD | MUMBAI | |
| | | CMI LIMITED | FARIDABAD | |
| | | CORDS CABLE INDUSTRIES LTD | NEW DELHI | |
| | | CRYSTAL CABLE INDUSTRIES LTD | KOLKATA | |
| | | DELTON CABLES LTD | NEW DELHI | |
| | | DIAMOND POWER INFRASTRUCTURE LTD | VADODARA | |
| | | ELKAY TELELINKS LTD | NEW DELHI | |
| | | GEMSCAB INDUSTRIES LTD | NEW DELHI | |
| | | GOVIND CABLE INDUSTRIES | KOLKATA | |
| | | GUPTA POWER INFRASTRUCTURE LIMITED | BHUBNESWAR | |
| | | HAVELLS INDIA LIMITED | NOIDA | |
| | | INCOM CABLES (P) LTD | NEW DELHI | |
| | | KEI INDUSTRIES LTD | NEW DELHI | |
| | | KRISHNA ELECTRICAL INDUSTRIES LTD | GWALIOR | |
| | | KEC INTERNATIONAL LIMITED | MUMBAI | |
| | | MANSFIELD CABLES COMPANY LTD | NOIDA | |

| SR. NO. | ITEM | SUPPLIERS | PLACE | REMARKS |
|---|---|---|---|---|
| | | NICCO CORPORATION LTD | KOLKATA | |
| | | PARAMOUNT COMMUNICATIONS LTD | NEW DELHI | |
| | | POLYCAB WIRES PVT. LTD | MUMBAI | |
| | | RAVIN CABLES LIMITED | MUMBAI | |
| | | SUYOG ELECTRICALS LTD | VADODARA | |
| | | SPECIAL CABLES PVT. LTD | NEW DELHI | |
| | | SCOT INNOVATION WIRES AND CABLES PVT. LTD | SOLAN | |
| | | SAM CABLES & CONDUCTORS (P) LTD | UDHAM SINGH NAGAR | |
| | | SPM POWER & TELECOM PVT. LTD | HYDERABAD | |
| | | TORRENT CABLES LTD | AHMEDABAD | |
| | | THERMO CABLES LTD | HYDERABAD | |
| | | TIRUPATI PLASTOMATICS PVT. LTD | JAIPUR | |
| | | UNIVERSAL CABLES LTD | SATNA | |
| | | M/s Lapp | | |
| | | M/s Furukawa | | |
| | | M/s RPG | | |
| 21. | TRAILING CABLES | NICCO | KOLKATA | |
| | | UNIVERSAL | SATNA | |
| | | INCAB | | |
| | | ICL | NEW DELHI | |
| | | APAR INDUSTRIES LTD | MUMBAI | |
| | | CMI LTD | FARIDABAD | |
| | | KEI INDUSTRIES LTD | NEW DELHI | |
| | | SUYOG ELECTRICALS LTD | VADODARA | |
| 22. | XLPE POWER CABLES | APAR INDUSTRIES LTD | MUMBAI | |
| | | CORDS CABLE INDUSTRIES LTD | NEW DELHI | |
| | | CRYSTAL CABLE INDUSTRIES LTD | KOLKATA | |
| | | DIAMOND POWER INFRASTRUCTURE LTD | VADODARA | |
| | | GEMSCAB INDUSTRIES LTD | NEW DELHI | |
| | | GOVIND CABLE INDUSTRIES | KOLKATA | |
| | | GUPTA POWER INFRASTRUCTURE LIMITED | BHUBNESWAR | |
| | | HAVELLS INDIA LIMITED | NOIDA | |

| SR. NO. | ITEM | SUPPLIERS | PLACE | REMARKS |
|---|---|---|---|---|
| | | KEI INDUSTRIES LTD | NEW DELHI | |
| | | KRISHNA ELECTRICAL INDUSTRIES LTD | GWALIOR | |
| | | KEC INTERNATIONAL LIMITED | MUMBAI | |
| | | MANSFIELD CABLES COMPANY LTD | NOIDA | |
| | | PARAMOUNT COMMUNICATIONS LTD | NEW DELHI | |
| | | POLYCAB WIRES PVT. LTD | MUMBAI | |
| | | RAVIN CABLES LIMITED | MUMBAI | |
| | | SUYOG ELECTRICALS LTD | VADODARA | |
| | | SPECIAL CABLES PVT. LTD | NEW DELHI | |
| | | SCOT INNOVATION WIRES AND CABLES PVT. LTD | SOLAN | |
| | | SRIRAM CABLES PVT. LTD | NEW DELHI | |
| | | TORRENT CABLES LTD | AHMEDABAD | |
| | | THERMO CABLES LTD | HYDERABAD | |
| | | TIRUPATI PLASTOMATICS PVT. LTD | JAIPUR | |
| | | M/s Lapp | | |
| | | M/s Furukawa | | |
| | | M/s RPG | | |
| 23. | **XLPE CONTROL CABLES** | APAR INDUSTRIES LTD | MUMBAI | |
| | | CABLE CORPORATION OF INDIA LTD | MUMBAI | |
| | | CRYSTAL CABLE INDUSTRIES LTD | KOLKATA | |
| | | DIAMOND POWER INFRASTRUCTURE LTD | VADODARA | |
| | | GEMSCAB INDUSTRIES LTD | NEW DELHI | |
| | | HAVELLS INDIA LIMITED | NOIDA | |
| | | KEI INDUSTRIES LTD | NEW DELHI | |
| | | KRISHNA ELECTRICAL INDUSTRIES LTD | GWALIOR | |
| | | KEC INTERNATIONAL LIMITED | MUMBAI | |
| | | PARAMOUNT COMMUNICATIONS LTD | NEW DELHI | |
| | | POLYCAB WIRES PVT. LTD | MUMBAI | |
| | | RADIANT CORPORATION PRIVATE LIMITED | HYDERABAD | |
| | | RAVIN CABLES LIMITED | MUMBAI | |

| SR. NO. | ITEM | SUPPLIERS | PLACE | REMARKS |
|---|---|---|---|---|
| | | SUYOG ELECTRICALS LTD | VADODARA | |
| | | SRIRAM CABLES PVT. LTD | NEW DELHI | |
| | | TORRENT CABLES LTD | AHMEDABAD | |
| | | UNIVERSAL CABLES LTD | SATNA | |
| | | M/s Lapp | | |
| | | M/s Furukawa | | |
| | | M/s RPG | | |
| 24. | CABLE GLAND | COMMET | | |
| | | SUNIL&CO | | |
| | | ARUP ENGINEERING | | |
| | | JAINSON | | |
| | | DOWELL | | |
| | | ALLIED TRADERS & EXPORTERS | NOIDA | |
| | | BALIGA LIGHTING EQPT.PVT.LTD. | CHENNAI | |
| | | ELECTROMAC INDUSTRIES | MUMBAI | |
| | | INCAB | KOLKATA | |
| 25. | PUSH BUTTONS | SIEMENS | | |
| | | L&T | | |
| | | BCH | | |
| | | SCHNEIDER | | |
| 26. | LIMIT SWITCHES | SPEED-O-CONTROL | | |
| | | ELECTROMAG | | |
| 27. | MASTER CONTROLLER | SPEED-O-CONTROL | | |
| | | ELECTROMAG | | |
| 28. | SAFETY SWITCHES | ALSTOM | | |
| | | L&T | | |
| | | SIEMENS | | |
| 29. | PENDENT PUSH BUTTON STATION | OEM | | |
| 30. | INDICATING LAMPS | TECKNIC | | |
| | | BCH | | |
| | | SIEMENS | | |
| | | | | |
| | | | | |
| | | STANDARD | | |
| 31. | MCB | MDS | | |
| | | INDO COPP | | |
| | | STANDARD | | |
| | | SIEMENS | | |

| SR. NO. | ITEM | SUPPLIERS | PLACE | REMARKS |
|---|---|---|---|---|
| | | L&T | | |
| | | ABB | | |
| | | SCHNEIDER | | |
| 32. | PANELS | Instrumentation Ltd | | |
| | | RITTAL | | |
| | | PYROTECH | | |
| | | Hoffman | | |
| 33. | RESISTANCE BOXES | ENAPROS | | |
| | | OEM | | |
| 34. | FIRE EXTINGUISHERS | ASKA EQUIPMENTS LTD. | | |
| | | ASHOKA ENGINEERING COMPANY | | |
| | | KANADIA FYR FYTER PVT. LTD | | |
| | | NITIN FIRE PROTECTION INDUSTRIES LTD | | |
| | | NEW ENGINEERING CORPORATION | | |
| | | SAFEX FIRE SERVICES LTD | | |
| | | UNITED FIRE EQUIPMENTS PVT. LTD | | |
| | | ZENITH FIRE SERVICES (INDIA) PVT LTD | | |
| | | M/s Ceasefire | | |
| | | M/s Steelage Minimax | | |
| | | M/s Siemens | | |
| 35. | VVVF | Yokogawa | | |
| | | ABB | | |
| | | SIEMENS | | |
| | | SCHNIEDER | | |
| | | FUJI ELECTRIC | | |
| | | MITSUBISHI ELECTRIC | | |
| | | CGL | | |
| 36. | SHROUDED DSL | SUSHEEL | | |
| | | STROMAG | | |
| 37. | ANTI COLLISION DEVICE | ELECTRONIC SWITCHES INDIA | | |
| 38. | LOAD CELL | IPA | | |
| | | SARTORIUS | | |
| 39. | RRC | ACROPOLIS ENGINEERING | - | |
| | | SNT CONTROLS | - | |

| SR. NO. | ITEM | SUPPLIERS | PLACE | REMARKS |
|---|---|---|---|---|
| 40. | GEAR BOX | OEM | | * = Applicable for Geared Motors only |
| | | ELECON ENGINEERS | | |
| | | SHANTI GEARS | | |
| | | PBL* | | |
| | | NAW* | | |
| | | NORD* | | |
| | | SEW* | | |
| | | BONGFILIOLI* | | |
| 41. | RAIL | JSPL | | |
| | | SAIL | | |

**NOTE:**

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL.
2. MAKE OF ITEMS/EQUIPMENTS USED IN ORIGINAL CRANES ARE ALSO ACCEPTABLE.
3. BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.
4. THE INSPECTION CATEGORY WILL BE FINALISED AFTER AWARD OF CONTRACT DURING DETAILED ENGINEERING. HOWEVER THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.

## ANNEXURE-II LIST OF MANDATORY SPARES

### CONTROL PANEL

| | |
|---|---|
| 1. Indication Lamps | - 25 nos. |
| 2. Semaphor Indicator | - 2 nos. |
| 3. Control Fuse | - 25 nos. |
| 4. Control Switches / Selector Switches (Each Type) | - 1 no. |
| 5. Meters (Indication Only) (Each Type) | - 1 no. |
| 6. PLC Card | - 1no. for each type |
| 7. Relays (Protective and Aux.) (Each Type) | - 1 no. |
| 8. Power Supply Card / units for relays (Each Type) | - 1 no.(If applicable) |
| 9. Hooter / bell etc | - 1 no. each type |
| 10. Isolating switch | |
| a) AC supply | - 1 no. of each type |
| b) DC supply | - 1 no. of each type |
| 11. Terminal blocks | - 1 set |
| 12. Timers of each range | - 1 no. |

### AC motors

| | |
|---|---|
| 1. Drive | - 1 of each type |
| 2. Bearings | - 1 set of each type |
| 3. Fans | - 1 no. each type |

Note:-

1. Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc. these shall cover all the items supplied. replaced and installed during refurbishment.
2. In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed in the above list.
3. Any item which is quoted as “not applicable” in the above list and is found to be “applicable” at a later date shall be supplied by the Bidder without any commercial implications. The Bidder shall note that if there in any change/ variation in equipment/ system during detail engineering which causes any change/ variation in the essential spares quantity, the same shall be supplied without any commercial implications. The price indicated for the mandatory spares shall be considered for the purpose of evaluation.
4. Mandatory spares shall not be dispatched before dispatch of corresponding main equipment. The spares shall be treated and packed for a long storage under the climatic condition prevailing at site.
5. All spares supplied under this contract shall be strictly interchangeable with parts for which they are intended for replacements.

6. Each spare shall be clearly marked and labeled on the outside of the packing with its description. When more than one spare part is packed in single case, a general description of the contents shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purpose of identification. The spare shall be treated and properly packed for long term storage.

## ANNEXURE III - TOOLS & TACKLES

Following unused new set of special purpose tools, tackles and accessories along with detailed instructions and maintenance manual for the crane shall be supplied. Each tool and wrench shall be stamped so as to be identified, easy for its use. The tools shall be supplied in steel toolbox and with a copy of instruction manual. The items supplied shall be of the best quality and minimum the following shall be provided.

a) One (1) set of wrench spanner having sockets.
b) One (1) set of sliding bar for socket wrench.
c) One (1) torque wrench
d) One (1) set of Allen key set.
e) One (1) grease and oil gun.
f) One (1) hydraulically operated jack of suitable capacity for CT & LT wheels.
g) Any other if required
h) One (1) tool box with lock and double keys.

Note: - One set of tool and tackles with O&M manual in the toolbox shall be supplied. Further in addition to above mentioned items, if any other items is required for maintenance of crane, the same shall also be included as a part of maintenance tools by the bidder.

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## ANNEXURE IV

### PAINTING SPECIFICATION

1. Painting of crane before erection at site:

Surface preparation: All surfaces to be painted shall be thoroughly cleaned of dirt, grease, rust & mill scale. Removal of rust & scale shall be by hand brushing, power driven wire brushes.

Primer : Either of Aluminum zinc oxide / Red oxide zinc chromate/ Epoxy resin paint (cold cured) as per manufacturer's standard. 2 coat, DFT 25-30 µm per coat.

Finish Coat : Either of Synthetic enamel /Epoxy based finishing paint as per manufacturer's standard.
2 coat, DFT 25-30 µm per coat.

Total DFT : 100µ-125µ

2. Painting for components such as panels, electrical parts, motors etc. shall be as per as per manufacture's standard.
3. Colour Shade:

| SL. No. | Item Description | Colour Shade | Remarks |
|---|---|---|---|
| 1 | Crane Structure & lifting beam | Golden Yellow shade 356 as per IS-5 | Colour band-Black |
| 2 | Trolley and hook | Crimson shade 540 as per IS-5 | |
| 3 | Motors | As per manufacturer's standard | |
| 4 | Control Panels | Light Gray as per IS-5 | |

## ANNEXURE-V

## DRAWINGS/ DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT

**1.0.0** Following documents shall be submitted for the above refurbishment scope during detail engineering after placement of order on BHEL's vendor.
Sizing /selection of crane parts requiring renovation/ replacement shall be as per IS 3177.

Legend: A- Approval, I – Information

### BASIC ENGINEERING DRAWINGS/DOCUMENT

| S. No. | BHEL drawing No. | Title | No. of days for submission from date of LOI. | CATEGORY |
|---|---|---|---|---|
| 1 | PE-V0-470-501-A501 | Manufacturing Quality Plan (as applicable) with sub vendor list for Power house crane | 28 | A |
| 2 | PE-V1-470-501-A504 | Mechanism Sizing Calculation (for applicable items) for Power house cranes | 28 | A |
| 3 | PE-V0-470-501-A505 | General arrangement drawing of crane | 28 | A |
| 4 | PE-V0-470-501-A508 | General arrangement for PVC shrouded DSL. | 35 | I |
| 5 | PE-V0-470-501-A517 | Schematic circuit diagram | 35 | I |
| 6 | PE-V0-470-501-A518 | General Arrangement of panels (for component arrangement) and Radio Remote Control(RRC) details | 35 | I |
| 7 | PE-V0-470-501-A519 | Cable Sizing and cable schedule | 35 | I |
| 8 | PE-V0-470-501-A521 | Mandatory spare parts list | 42 | A |
| 9 | PE-V0-470-501-A522 | Data sheet for replaced items 135/20T Power house crane | 35 | A |
| 10 | PE-V0-470-501-A534 | Crane assessment report before refurbishment of cranes | 21 | I |
| 11 | PE-V0-470-501-A514 | Catalogues/Data sheet/Lubrication Schedule/Packing and storage guidelines for replaced parts | 42 | I |

Notes:

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.
2. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
3. Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.
4. Bidder to note that all values/dimensions/elevations etc. without supporting back up data adopted/assumed by the successful bidder (during contract stage) in the design

calculation/drawings shall be taken by the customer/owner to be correct unless they are stipulated in the specification. Any problem arising later in this regard shall be made good by the successful bidder at his cost and no extension of time shall be granted for the same.

5. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:-

a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.

b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.

c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.

d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.

e) Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C… etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 ….etc.

f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.

g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.

h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No.

i) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

j) Bidder to follow the following the drawing submission schedule:

i. 1st submission of drawings as per the submission schedule.

ii. Every revised submission incorporating comments – within 15 days.

k) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

# SECTION III

## DRAWINGS / DOCUMENTS TO BE SUBMITTED WITH THE BID

Bidder shall submit the following drawings / documents along with their bid:

a) Deviation schedule with reference to specific clauses of the specification along with reason for such deviation in the 'Deviation Schedule' (Cost of withdrawal) format as attached in GCC.

b) Un-priced copy of price format indicating quoted/ not quoted against each row/column

c) Copy of pre-bid clarifications/ amendment/ corrigendum issued by BHEL, if any, duly signed & stamped

d) Signed/ Stamped copy of Compliance cum Confirmation Certificate

OFFER WILL BE CONSIDERED AS INCOMPLETE IN ABSENCE OF ANY OF ABOVE DOCUMENTS. DOCUMENT OTHER THAN ABOVE, IF ANY, SUBMITTED WITH THE OFFER WILL NOT FORM PART OF CONTRACT AND WILL NOT BE CONSIDERED FOR BID EVALUATION.

## PRE-BID CLARIFICATION SCHEDULE

| S. NO. | SECTION/CLAUSE/PAGE NO. | STATEMENT OF THE REFERRED CLAUSE | CLARIFICATION REQUIRED |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

The bidder hereby clarifies that above mentioned are the only clarifications required on the technical specification for the subject package.

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal

## COMPLIANCE-CUM-CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing / stamping this compliance certificate (every sheet) and furnish same with the offer.

a) The scope of supply, technical details, construction features, design parameters, refurbishment requirements etc. shall be as per technical specification & there are no exclusions, other than those mentioned under "exclusion and those resolved as per 'Schedule of Deviations', with regard to same.

b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'.

c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.

d) All drawings/ data-sheets / calculations etc. submitted along with the offer, if not sought/required for bid evaluation shall not be taken cognizance off.

e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements, the same shall be resolved by the bidder during the pre-bid discussions, otherwise BHEL/Customer's decision shall be binding on the bidder, whenever the deficiency is pointed out.

   For components where materials are not specified, the same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same are deemed to be included in the base price.

g) All sub-vendors shall be subject to BHEL / CUSTOMER approval in the event of order.

h) Guarantee/Warranty for plant/equipment shall be as per relevant clause of GCC / SCC / other Commercial Terms & Conditions.

i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break-up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account.

j) Schedule of drawings/documents/quality plans submission, comment incorporation & approval shall be as stipulated elsewhere in the specification. The successful bidder shall depute his design personnel to BHEL's / Customer's / Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

k) As-built drawings shall be submitted as and when required during the project execution.

l) The bidder has not tampered with this compliance-cum-confirmation certificate and if at any stage any tampering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.

m) Successful bidder shall furnish detailed erection/installation manual for each of the equipment supplied under this contract as per the schedule of submission of documents and well before the scheduled erection of the equipment / component concerned.

n) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and shall require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

o) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.

# DRAWINGS OF EXISTING CRANES AND OTHER REFERENCE DRAWINGS

N°7049721 Fo

27' (8.229) 27' (8.229) 27' (8.229) 27' (8.229)

16' (4.877)

TRANSVERSAL SECTION SEE DRAWING 7049723

CONTROL SPHERICAL VALVE

COMMANDE VANNE

12' (3.658)

℄ OF CRANE RAIL

FIRE PROTECTION GENERATOR.

10 1177'

27'7" (8.407)

CONTROL VALVE DUCT

PUMP HANDLING AXIS

PUMPS

GOVERNOR CABINET

WEIGHT : 4 T. ABOUT

11.800 / 5' / 1.071/8

1'4" (406)

22'6" (6.858)

22'9" (6.934)

20'6" (6.248)

21'6" (6.553)

21'4" (6.503)

7'3 1/2" (4.013)

1'6" (459)

7'3 1/2" (4.013)

WATER WHEEL DISCHARGE FUNNEL

22'12" (6.756)

25' (7620)

20'2" (6.147)

2'1" (635)

4'9 3/4" (1.468)

6'7" (2.007)

1163 50'

MOORING HOOK FOR HAULING THE BEARING PARTS

BRAKING PANEL

COMPRESSED AIR TANK

COMPRESSOR SET

Compresseurs / Compressor

MATERIAL DISCHARGE AREA

(406) 1'4" 5'3" (1.600) 6'7" (2.007)

11 KV CABLES WAY

TO TRANSFORMERS 11/110 KV.

LONGITUDINAL SECTION SEE DRAWING 7049724

℄ OF CRANE RAIL

36'10" (11.227)

17'8 1/2" (5.400)

23' (7.010)

27'1" (8.407)

LOW TENSION POWER AND CONTROL CABLES WAY

LIFTING SET

26'9" (8153)

TO 1177

TO 110KV. SWITCHYARD

LONGITUDINAL SECTION SEE DRAWING 7049725

17' (5.182)

35'6" (10820)

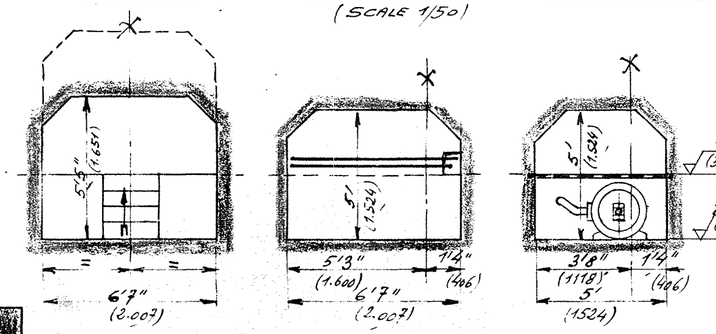
OVERLOADS ON MASONRIES

1 TON/SQUARE METRE

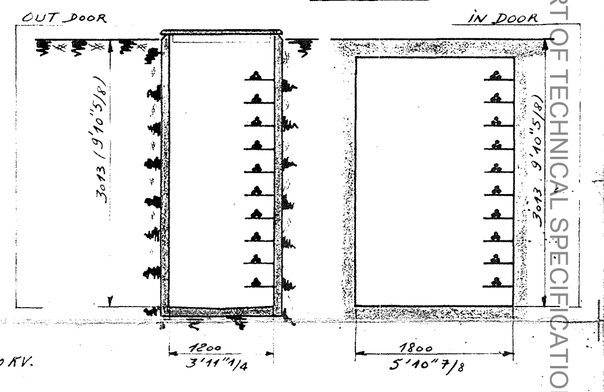
## SECTION C

## SECTION d (SCALE 1/50)

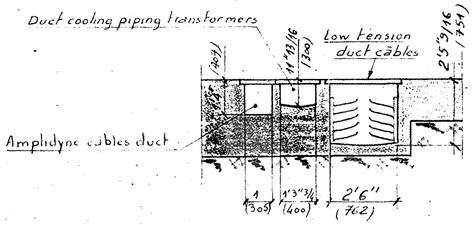
## SECTION e




## SECTION a SCALE 1/50




## SECTION b SCALE 1/50




E1 | 1 | 2

MADRAS STATE ELECTRICITY BOARD

# KODAYAR I POWER STATION

GENERAL DRAWINGS-FINAL SCHEME

PLANE VIEW LEVEL 1166'

PLANS GENERAUX DE PRINCIPE

VUE EN PLAN NIVEAU 1166'

Dessiné : JOAN
Vérifié :
Enregistré : 3.12.65

Echelle : 1/100
Service ERE-A 2
Cde N° 15/A0802

N° de Class. T.3

Rectifications following M.S.E.B's letter dt 2/7/66 (EH/A2/KDR. I/S) drawing KOD. 150.A/3R2 and ALSTHOM Note dt. 17.10.66 — 17.10.66 — B

Rectifications after letter MSEB and ALSTHOM ANS WED. (16.4.66). EH/A2/KDR.E.T.J. — 6.66 — A

ALSTHOM PARIS 38, AVENUE KLÉBER

N° 7049721 Fo

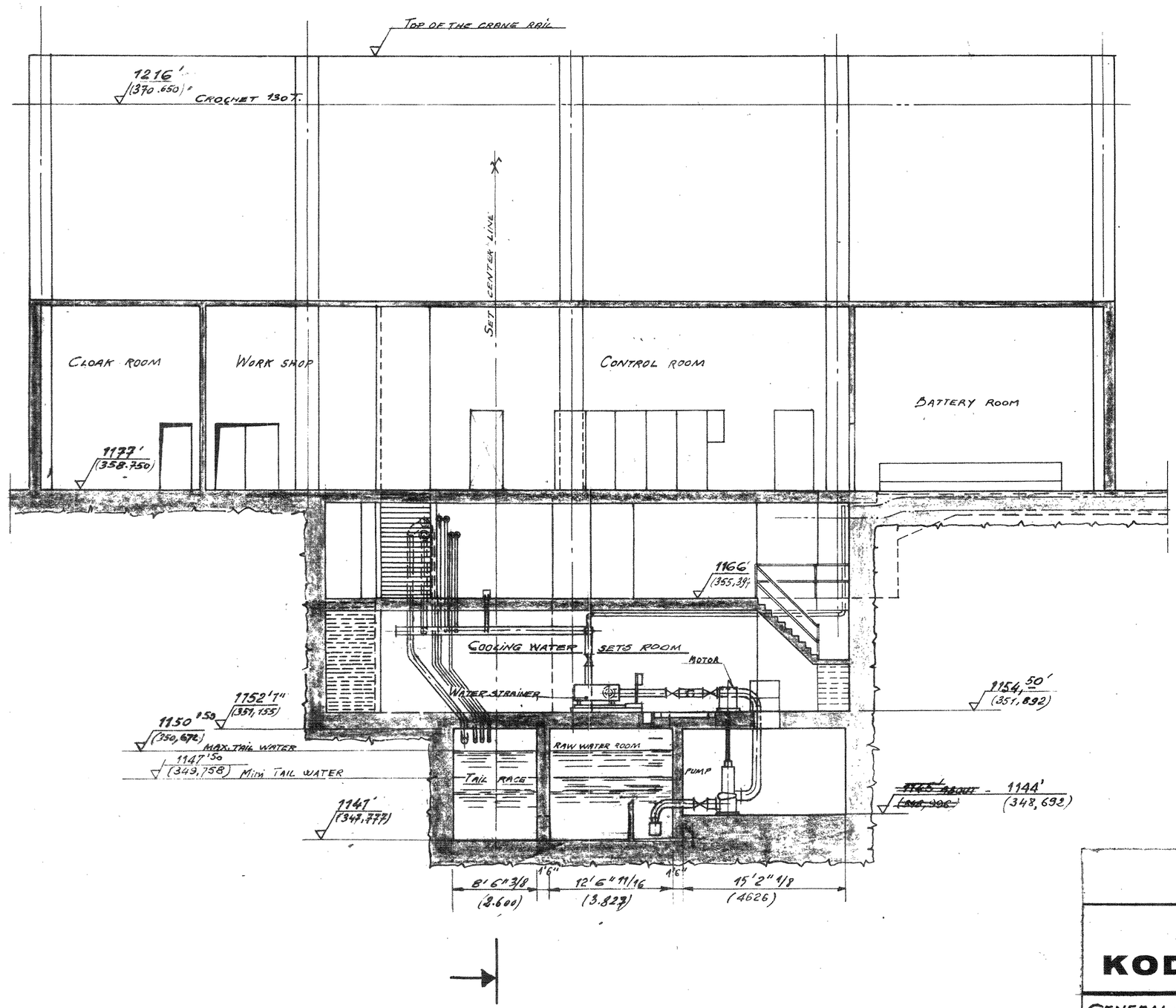
Nbre Fos 6 — Voir Fo —



N°7049721 Fo

N° 7049725 Fo

TRANSVERSAL SECTION
SEE DRAWING 7049723




E1 | 1 | 6

MADRAS STATE ELECTRICITY BOARD

# KODAYAR I POWER STATION

GENERAL DRAWINGS-FINAL SCHEME
LONGITUDINAL SECTION VIEW
OF DOWN STREAM BUILDING

PLANS GÉNÉRAUX DE PRINCIPE
COUPE LONGITUDINALE
DU BATIMENT AVAL

Dessiné : JOUAN
Vérifié :
Enregistré : 3-12-65
Echelle : 1/100
Service ERF/A2
Cde N°15/Pa/A2
N°de Classt

ALSTHOM PARIS 38, AVENUE KLÉBER

N° 7049725 Fe
Nbre Fs
Voir Fs

| | | |
|---|---|---|
| Rectifications following M.S.E.B's letter dt 2/7/66 (EH/A2/KDR. T/B) Drawing KOD 150. A/3A2 and ALSTHOM note dt 17-10-66 | 17.10.66 | B |
| Modifications EH/AE/KDR. E. 729 (A) 2 after-letter MSEB | 5.6.66 | A |



N° 7049725 Fo

N° 35-181829

To avoid injuries of the shaft during handling place between shaft and locking ring, copper shims 1 mm thickness.

Limit highest position 370, 650 (1216')

1479

A

A

Locking ring

Handling wrench

Total weight = 100 T

7050

750

Place between shaft and handling wrench 2 copper shims 0,8 mm thickness.

Cross-section AA

HM 10-20 screw

Assembling plate



| A4 | 2 | 2 |
|---|---|---|

**MADRAS STATE ELECTRICITY BOARD**

# KODAYAR I POWER STATION

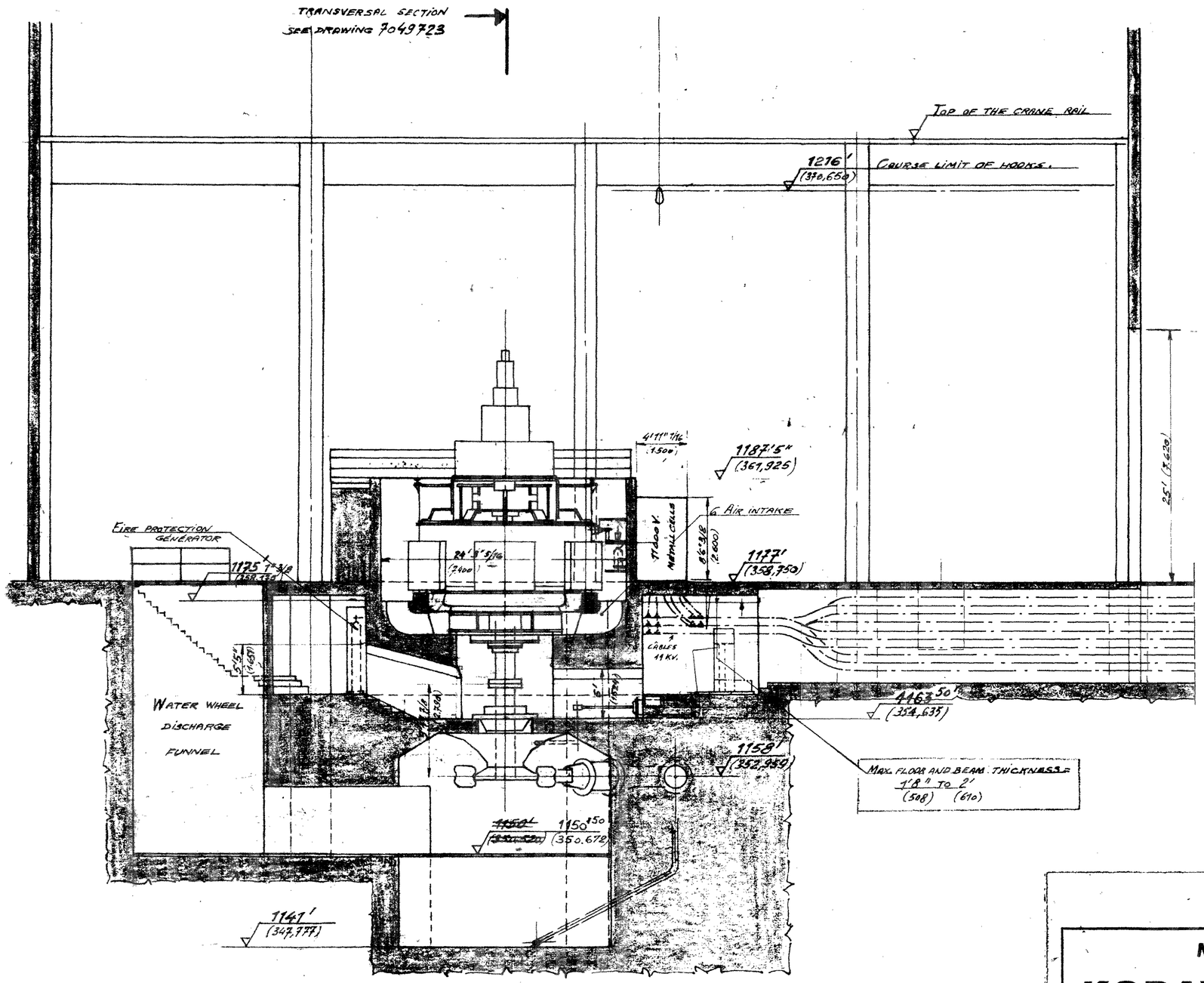
| Echelle | | |
|---|---|---|
| 0,05<br>0,1 | Rotor handling | Manutention du rotor<br>RYV - 422 - 147 |

| Dess. 9-3-67 | Vérif | Vu: | Remplace: | Remplacé par: |
|---|---|---|---|---|
| Raspiller | / | | N° de classement: | Consulter aussi: |

Modifications

ALSTHOM – BELFORT

N° 35-181829 bis








E1 | 1 | 5

MADRAS STATE ELECTRICITY BOARD

# KODAYAR I POWER STATION

~~GENERAL DRAWINGS FINAL SCHEME~~ ~~PLANS GÉNÉRAUX DE PRINCIPE~~

LONGITUDINAL SECTION VIEW OF POWER STATION

COUPE LONGITUDINALE DE LA CENTRALE

Dessiné : JOUAN | Echelle : 1/100 | N°de Class.
Vérifié :
Enregistré : 8.12.65 | Service ERE:A2 | Cde N°15/80808

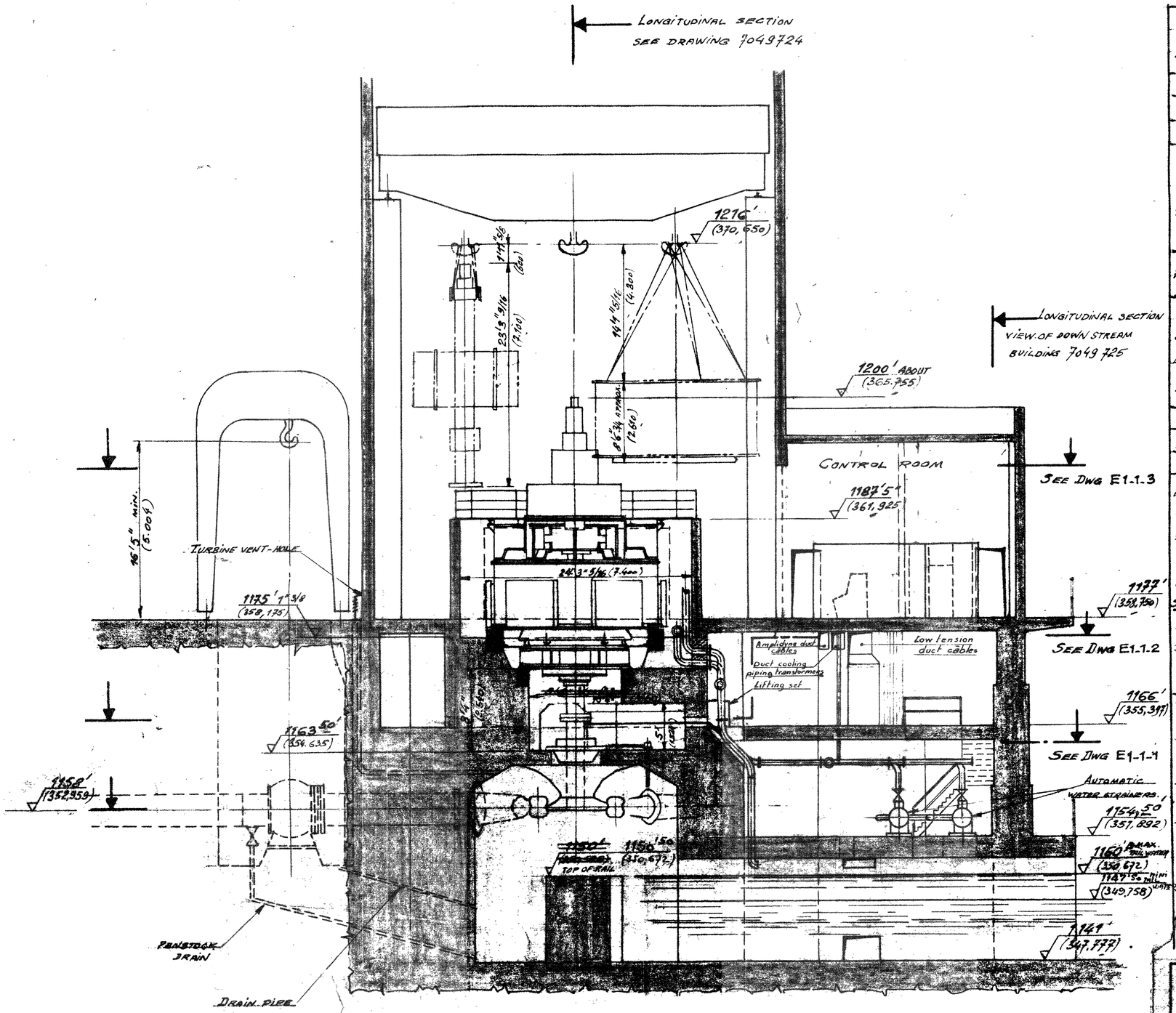
Rectifications following M.S.E.B.S letter dt 2/9/66 (EH/A2/KDR. T/a) Drawing KOD 450-A/382 and ALSTHOM note dt 17.10.66 — 17.10.66

Modifications (EH/A2/KDR.E.T/3 dt 2

ALSTHOM PARIS 38, AVENUE KLÉBER

N° 7049724 Fo

N° 7049723




## Repartition of the loads
## Répartition des charges

| | | |
|---|---|---|
| Total weight to be supported by the upper bracket consisting of : | 175 tons | Poids total à supporter par le croisillon supérieur, constitué de : |
| - Generator rotor | 110 tons | Rotor |
| - Thrust bearing with oil | 11 tons | Pivot avec huile |
| - Upper generator housing | 26 tons | Bâti supérieur |
| - Exciters | 8 tons | Excitatrices |
| Rotating parts of turbine | 20 tons | Turbine (parties tournantes) |
| **Loads on stator foundation plates** | | **Réactions sur les assises du stator** |
| **Vertical reactions** (6 foundations plates) | | **Réactions verticales** (6 Assises) |
| - Total static load on stator foundation plates (inclusive of loads due to turbine-runner and thrust bearing) (1) | 255 tons | Charge statique totale sur les assises du stator (Roue turbine et pivot compris) |
| - Static load on each foundation plate (1) | 42,5 tons | Charge statique par assise |
| These two loads should be multiplied by coëfficient 2 to take the dynamic effects into account | | Ces 2 charges sont à multiplier par le coefficient 2 pour tenir compte des effets dynamiques |
| **Horizontal reactions** | | **Réactions horizontales** |
| - Normal torque due to the machine | 117 tons/meter | Couple normal du groupe |
| - Maximum torque due to instantaneous symetrical short-circuit | 1065 tons/meter | Couple maximum en cas de court-circuit instantané symétrique |
| - Circumferential shearing force on each foundation-plate : | | Effort de cisaillement circonférenciel par assise du stator : |
| = For normal current | 7,65 tons | - Pour le courant normal |
| = For instantaneous symetrical short-circuit current | 70 tons | - Pour le courant court-circuit instantané symétrique |
| **Reactions on the arms of the lower spider supporting "generator braking and lifting jacks"** | | **Réactions sur les bras du croisillon inférieur portant les vérins "freinage-levage"** |
| **Vertical reactions** (6 arms) | | **Réactions verticales** (6 bras) |
| - Weight of rotating parts (Generator, exciters and turbine rotating parts) | 135 tons | Poids des parties tournantes (Rotor alternateur, rotor excitatrices et turbine) |
| - Static load per foundation plate of the lower spider in case of rotor lifting (1) | 26 tons | Charge statique par assise du croisillon inférieur en cas de soulèvement du rotor |
| - Vertical load per arm in case of braking | 1 ton about | Charge verticale par bras en cas de freinage |
| **Horizontal reactions** | | **Réactions horizontales** |
| - Reaction due to friction when brakes are applied needs | 0,3 ton about | - Réaction due au frottement lors du freinage |
| - Total radial loads due to the resultant of the jets of the turbine at full load, and transmitted : | | - Charges radiales totales dues à la résultante des jets de la turbine à puissance maximum, et transmises : |
| = On the generator lower bearing and lower spider | 55 tons | = Sur le palier inférieur alternateur et le croisillon inférieur |
| = On the support of the turbine bearing at level 1163'50 | 136 tons | = Sur le support du palier turbine au niveau 1163'50 |

**NOTA (1)**

| Static loads on stator foundation plates : | Normal case | Case of rotor lifting |
|---|---|---|
| - Total | 255 tons | 120 tons |
| - On each foundation plate | 42,5 tons | 20 tons |
| **Static loads on foundation plates of the lower spider :** | | |
| - Total | 21 tons | 156 tons |
| - On each foundation plate | 3,5 tons | 26 tons |

ALL LOADS ARE INDICATED IN METRIC TONS

E1 | 1 | 4

MADRAS STATE ELECTRICITY BOARD

# KODAYAR I POWER STATION

General drawings - Final scheme
Transversal section view of power station

Plans généraux de principe
Coupe transversale de la centrale

Dessiné : Levaan | Echelle : 1/100 | N°de Classt
Vérifié : | Service ERE-A2
Enregistré : 3-12-1965 | Cde N°75/Bo202

ALSTHOM PARIS 38, AVENUE KLÉBER

Rectifications following MSEB's letter dt 2/9/66 [EH/A2/KDR.T/2] drawing KOD.150.A/3A2 and ALSTHOM Note dt. 17-10-66 — 17.10.66 B
Modifications [EH/A2/KDR-E.729(8)2] — 6.6.66 A

N° 7049723 F° | Nbre F° | Voir F° | B | A

# PHOTOGRAPHS OF EXISTING CRANES FOR REFERENCE


HINDUSTAN CRANE
HINDUSTAN MOTORS LTD.
SWL 135000
20000


HINDUSTAN MOTORS LTD.
SWL 135000 kg MAIN HOIST
20000 kg AUX. HOIST