HIMACHAL PRADESH POWER CORPORATION LTD

CHANJU-III-HEP (3X16 MW)

TECHNICAL SPECIFICATION FOR POWER HOUSE CRANE
DOUBLE GIRDER EOT CRANE - 63/8T

SPECIFICATION NO.: PE-TS-541-501-A001 Rev 00

BHARAT HEAVY ELECTRICALS LIMITED
(A Govt. of India Undertaking)
POWER SECTOR, PROJECT ENGINEERING MANAGEMENT
NOIDA (U.P.) -201301
INDIA

INDEX

SECTION I
SPECIFIC TECHNICAL REQUIREMENTS

SUB-SECTION IA: Specific Technical Requirements (Mechanical)
SUB-SECTION IC: Data Sheet-A

1. SCOPE OF ENQUIRY / INTENT OF SPECIFICATION

1.1 This specification includes, but not limited to SUPPLY PART, SERVICE PART & MANDATORY SPARES comprising of design, engineering, manufacture, supply, erection, testing & commissioning, training of Employer's personnel, Annual Maintenance Contract, handing over and guarantee of EOT crane for **POWER HOUSE** complete with all auxiliaries, accessories, spare parts and warranting a trouble-free safe operation of the installation for project and package specified above complete with all accessories 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, erection & commissioning and load testing of the cranes and its accessories**.

1.3 It is not the intent to specify herein all the details of design and manufacture. 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**.** 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. Further all checks and tests indicated in "QUALITY ASSURANCE PLAN" (customer's QAP).

SUB SECTION IA
SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

1.0.0. SCOPE OF WORK

1.1.0. SCOPE OF SUPPLY

1.1.1. Equipment and services to be furnished by the bidder for the EOT CRANE with accessories as per the details given in the technical specification and data sheet A. Any equipment / accessories not specified in the specification but required to make the EOT crane complete for efficient & reliable operation shall also be under the bidder's scope of work.

1.1.2. Compliance with this specification shall not relieve the bidder of the responsibility of furnishing material and workmanship to meet the specified working/duty conditions.

1.1.3. A) One (1) number 63/8 T Double Girder EOT Crane for Power House area shall include but not be limited to the following: -

a. Bridge girders
b. End carriages with wheels
c. Crab (trolley)
d. Cross Travel & Long Travel drive arrangement
e. Operator's Cabin.
f. All electrical equipment including cables, junction box, VVVF drive, pendent, RRC, panels etc.
g. PVC insulated shrouded bus bar Cu conductor type DSL along with insert plates (fixing plates for DSL) to be mounted at RCC girder.
h. Earthing arrangement
i. Fill of lubricant till commissioning of crane. Oil and grease required for first filling with 10% excess quantity.
j. Painting of cranes and accessories
k. One (1) no. flexible power cable (Half the bay length +25 m) of suitable size as per load calculation for commissioning, testing & operation of EOT Crane till such time the DSL is charged.
l. Rail complete with sole plates, anchor bolts, clamps etc. including all accessories and end stopper to be mounted at RCC girder.
m. One (1) set of Maintenance tools & Tackles for operation and maintenance.
n. Erection & Commissioning spares.
o. One (1) set of Mandatory Spares.
p. Main Isolating switch in enclosure at operating floor for incoming power supply from two boards.
q. Power cables from two nos. supply boards to the Main Isolating switch / Changeover to be located at middle of the bay length. Electrical supply feeders shall be provided by BHEL from Station service boards (SSBs) placed EL1627m control block near Service bay. Refer "Section IA- reference Drawings" of this specification.

r. One (1) number lifting beam of Capacity 63 T with all required accessories

s. One (1) set of fabricated lifting beam stand (s) support for beam.

t. Three (3) sets each, of nylon slings, of reputed make as per relevant standards.

u. A Static type hydraulic lifting table consisting of elevating platform, base frame, and scissor type mechanism connected with elevating platform and base frame. The hydraulic lifting table shall be mounted at suitable location on trolley of EOT crane so as to be suitable for working on the crown of P/H. The platform shall be of capacity 500 kg, size 1300 mm x 900mm.

1.1.4 **Makes of Sub- Vendor Items**

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

1.1.5 **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-IA of this specification.

1.1.6 **Maintenance Tools and Tackles**

As per Annexure III, section-IA of this specification

1.1.7 **Painting & Colour Scheme**

As per Annexure IV, section-IA of this specification

1.1.8 **Erection and Commissioning spares**

The Bidder shall also supply erection & commissioning spares along with his main equipment 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 supply all equipment complete with initial fill of fluids, grease or lubricants, in drums / containers. Bidder shall supply minimum following spares.

i)	Oil seal for each gear box	1 Set
ii)	Indicating Lamps 1 no. of each type	1 Set
iii)	Push Button 1 no. of each type	1 Set
iv)	Aux. contactor 1 no. of each size	1 Set
v)	Limit switches- 1 no. of each type	1 Set
vi)	Any other spare/s, as per experience of bidder	1 Set

Note:

a. Any spare, not quoted by bidder, but required during commissioning shall be supplied by bidder without any additional cost.

b. One set means 100% requirement of one crane.

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

1.1.10 Packing as per Annexure VI, forwarding and transportation to delivery address as per SCC.

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

1.2.1. Packing, forwarding, transportation and unloading at site including ward & watch of the equipment.

1.2.2. Visits during material verification for MRC shall be provided by bidder at site. Bidder shall be informed at least 10 days in advance for the requirement of visit at site. Visiting team shall consist of experts of bidder as deemed necessary.

The following parts shall be stored in weather proof containers till the completion of scope of work. The containers shall be supplied by bidders on returnable basis.

Bolts, pins, packing, tools, insulation materials, electrical parts with electrical devices, electric motors, instruments, welding material and equipment, all final painted parts of the crane.

Large parts shall be provided with weather & fire-resistant covers.

1.2.3: The bidder shall inform himself fully as to all relevant transport facilities and requirements, loading gauges and other limitations and shall ensure that the equipment as prepared for transport shall conform to such limitations. The Bidder shall also be responsible for obtaining from the Indian railway or highway authorities any permit that may be required for the transport of loads exceeding the normal gauges.

1.2.4 Arranging test load at site.

Collecting the test load at site from approximate 10 km from owner's storage to final testing bed of crane shall be bidder's scope of work. The test load in the form of rolled steel, plates, girder, angle etc., as available at the site shall be made available by the purchaser. The test load shall be put back to the place from where it was lifted by the vendor, after the load testing. Load testing sling, cradles and any other item required by the vendor during the load testing shall be arranged by the vendor at no extra cost to the purchaser. Slings & cradles will be allowed to be taken back by the vendor, after completion of the test at site.

1.2.5 Erection and Commissioning of EOT cranes and all accessories.

1.2.6 Demonstration / Load test at bidder's Works and at Site.

1.2.7 Obtaining clearance and acceptance certificate from the concerned competent Authority after site test and as and when required as per Government Norms /Statutory body till the time of final handling over to Customer. Necessary fees/expenditure as required shall be borne by the supplier.

1.2.8 Training to Customer's Operation & Maintenance staff.

1.2.9 Any service mentioned in GCC & SCC as relevant to the package.

1.3.0 Exclusions

Supply feeder.
Civil work. However, bidder shall coordinate with Civil agency during casting of gantry girder for proper alignment of anchor bolts, insert plates, sole plate etc to their satisfaction for further erection of rail and DSL.
RCC Gantry girder.
Space for storage.
Development of storage space.
Transportation of materials from store to erection site.
Exclusion, if any, mentioned in GCC, SCC.

2.0.0 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-A of this specification.

3.0.0 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 in Sec III 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**.**

4.0.0 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. Refer clause 6.10.2 of CUSTOMER SPECIFICATION – CHAPTER 6 EOT CRANE FOR POWER HOUSE.

4.1.0 Testing at Works

Refer section IA: "QUALITY ASSURANCE PLAN" (customer's QAP)**"** and cl. No. 6.9 & 6.10 of Customer specification.

4.2.0 Testing at Site

4.2.1 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 under supervision of bidder's representative.

i. Deflection test of bridge girder at rated load.

ii. Load test and Overload test (running of CT and Hoisting mechanism at 125% of the rated load). 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

Note: The test shall be carried out with actual panels, RRC, Master controller etc.

5.0 Consumables

The Bidder's scope includes requirements of consumables such as oils, lubricants including grease, servo fluids, gases and essential chemicals etc. till handing over. Consumption of all these consumables till handing over shall also be included in the scope of the Bidder. Bidder shall also supply a quantity of the full charge of each variety of lubricants, servo fluids, gases, chemicals etc. used which is expected to be utilized till handing over. This additional quantity shall be supplied in separate containers.

6.0 ANNUAL MAINTENANCE CONTRACT (REQUIREMENTS FOR HEALTHINESS CHECK)

The scope of work is mentioned in quarterly and annual schedule. Any other work as deemed necessary to ensure healthiness of the crane shall be performed. Detailed report along with repair, replacement of parts as required shall be submitted to BHEL after each visit, for further maintenance work by BHEL.

S. No.	Equipment/Item	Scope of work	Schedule
1.	Bridge and Trolley wheel assembly	Checking for wear, flat spots and cracks in flange. Ensure drive wheels are of the same diameter.	Quarterly
2.	Runway rail	Checking alignment and elevation of rail track. Check rail clamp, bolts, blocks etc.	Quarterly
3.	Machine Bolts	Checking all foundation bolts of Electrical and Mechanical equipment for tightness.	Quarterly
4.	Structural Bolts	Checking for tightness. They should also be checked after the first month of operation.	Quarterly
5.	Flexible Couplings	Checking pins and teeth for wear, cleaning and greasing	Quarterly
6.	Cross-shaft Plummer Blocks	Checking oil seals for cleaning.	Quarterly
7.	Trolley Collectors	Checking of cable trolleys / cabling / chain for connection of trolley wheels through entire length of span.	Quarterly
8.	Brakes	All Brake assembly will be checked for loose connection, earthing connection, linings for wear, leakages and adjustments to ensure brake is not rubbing the brake drum during operation. Checking for greasing pins and operation adjustment of brakes	Quarterly
9.	Resistor Connections	Checking, tightening connections at grid joints and at cable terminations.	Quarterly
10.	Radio remote controller, Master controller, Pendant	Checking of all connection at push buttons, master controllers contact tips, cams and terminals & functional checks.	Quarterly
11.	Panels	All Panels will be checked for loose connection and contactor contacts, components including VVVFD's, DBR healthiness.	Quarterly
12.	Electrical Motors	All motion motors connection will be checked for loose contacts in terminal box loose crimping of wire lugs, loose contacts on slip ring assembly with carbon brush.	Quarterly

		Earthing connection with motor.	
13.	Safety Switches	All limit switches will be checked for desired operation and limits. Emergency switches will be checked.	Quarterly
14.	Main Current collectors, LT DSL	Checking of worn collector shoes, sag in main runway wiring, ensuring contact is kept through entire length runway properly.	Quarterly
15.	Electrical connections	Checking throughout electrical equipment for loose connection such as selector switches, junction boxes, min isolator switch etc.	Quarterly
16.	Lubrication	All gear box and thrusters' oil level will be checked. All bearings, couplings' grease will be checked.	Quarterly
17.	Operational check of crane	Trolley will be checked for idle operation, for brake operation, limit switch operation & safety switch operation. All motor currents will be checked on no load. Check for abnormal sound /jerk during operation.	Quarterly
18.	Gear Boxes	Oil seals will be checked for replacement. Gear and pinion teeth will be checked. Grease/ Oil check.	Annually
19.	Motor	All motors' insulation test and meagre test will be carried out.	Annually
	REQUIREMENTS FOR HANDING OVER OF CRANES		
1	Handing over of crane/s to End Customer, in smooth and working condition (after closing all punch points), signing of protocols for hand over shall be in bidder's scope.		
2	Any item/s, manpower & services required for closure of punch point and hand over shall be in bidder's scope. For item/s refer sl no 3 below.		
3	Unused Operation & Maintenance spares, as available, during closure of punch point to facilitate handing over of cranes shall be issued by BHEL to the bidder. However, bidder at their own discretion may also envisage suitable spares or additional quantity that may be required to facilitate handing over. For list of Operation & Maintenance spares being purchased from bidder by BHEL, as per below list.		

S. No.	**Description (Operation and maintenance Spares)**	**Qty. (Power House Crane)**	**UOM**
1.	Gear Oil in sealed packets/containers.	20	litres
2.	Grease in sealed packets/containers.	20	kg
3.	Brake Oil in sealed packets/containers.	20	litres
4.	Cardium compounds in sealed packets/containers.	20	kg
5.	Brake shoes	4	Set
6.	Brake liners	4	Set
7.	Brake springs	4	Set
8.	Oil seal for gear box	4	Set
9.	Main & auxiliary contactors of each type and rating	2	Set
10.	Overload relays of each rating	2	Set
11.	Bearing for motors of each size and rating	4	Set
12.	Limit switch of each type and rating	4	Set
13.	Push button of each type and rating	2	Set
14.	Panel lights, indicating lamps etc	2	Set
15.	Main Isolating switch cum Changeover with box and lever	2	No.
16.	Fuse of each type and rating	2	Set
17.	MCB/MCCB of each type and rating	2	Set
18.	Under bridge and over bridge lights of each type and rating	2	Set
19.	Tags for cables, panels, JBs etc.	2	Set
20.	Master Controllers for all motions	2	Set
21.	Accessories i.e Rail clamps, alignments blocks, washers, springs, bolts etc. for rail fixing.	For approximately 3% of total rail length	
Note for Operation and maintenance Spares: -			

1.	Operation and maintenance spares shall be supplied in separate box/container clearly marked "O & M spares" with individual Machined Components/Assemblies/Equipment, Electrical & Electronic Components/Assemblies protected as per the packing defined in "Packing Requirement" of this specification.
2.	Grease, lubricants, oils, compounds etc shall be supplied is such size of packets/containers so that they are opened and utilized in one application/use.
3.	One (1) Set is defined as 100% requirement for one crane.
4.	Operation and maintenance spares shall be used for general/breakdown maintenance during operation and also during periodic healthiness check services (to be provided by crane vendor). Unused Operation & Maintenance spares, as available, during closure of punch point to facilitate handing over of cranes shall be issued by BHEL to the bidder. However, bidder at their own discretion may also envisage suitable spares or additional quantity that may be required to facilitate handing over.

SECTION IA

QUALITY ASSURANCE AND INSPECTION REQUIREMENT

1.1.0. Inspection and Testing

Bidder shall submit Manufacturing Quality Plan (MQP) based on the guidelines given in the specification & MQP enclosed herein. Format shall be as agreed with Customer in line with Customer's specification "QUALITY ASSURANCE PLAN" (customer's QAP)" and cl. No. 6.9 & 6.10 of Customer specification.

1.1.1. Inspection and testing at Manufacturer's works

Copy of approved documents with stamp and signature (one set) shall be available at the place of Inspection which shall be ensured by supplier.

Shop inspection and tests will include but not limited to the following –

STAGE INSPECTION

Stage inspection of various components of crane shall be guided by the MQP approved during detail engineering. Indicative MQP is attached in the specification. However, following shall be ensured and read in conjunction with relevant clause of MQP w.r.t. stage inspection:

i. All test certificates shall be in original and legible. Photocopies certified by Mill/ manufacturer of raw material used, are acceptable.

ii. For tensile testing of hooks/ forgings, samples shall be drawn from the full cross section of the shank diameter of hooks/ forgings Samples forged to reduced cross section for testing purposes is not acceptable. **Hooks shall be manufactured from Blooms, billets, rounds by forging with forging ratio of at least 3:1. Hooks manufactured from plates are not acceptable.**

iii Radiographs shall be inspected to a sensitivity of 2%.

iv Ultrasonic test on forgings and casting of critical components like cross head (hook suspension block), Hooks, Shafts, Axles, Gears, Wheels, Pulleys etc. Ultrasonic test on forgings shall be carried out as per norms given below. UT shall be carried out in Proof machined condition (single diameter/ Flat surface without steps, keyways, teeth cutting or other profile machining which can create difficulty in ultrasonic testing). Components shall be identified with Heat number and serial number by punching). Hardening operation shall be carried out prior to Ultrasonic testing.

Unacceptable defects in forgings are as given below:

1. Cracks, flakes, seams and laps
2. Defects giving indication larger than '4 (four) mm diameter equivalent flaw' except for wheels for which Defects giving indication larger than '6 (six) mm diameter equivalent flaw.'
3. Group of defects with maximum indication less than that from a 4 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced by 50% except for wheels for which Group of defects with maximum indication less than that from a 6 mm dia. equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced by 40%.

4. Defects giving indication of 2 to 4 mm dia. equivalent flaw, separated by a distance less than 4 (four) times the size of the larger of the adjacent flaws except for wheels for which Defects giving indication of 3 to 6 mm dia. Equivalent flaw, separated by a distance less than 4 (four) times the size of the larger of the adjacent flaws Ultrasonic test on Castings shall be carried out as per ASTME 609.

   Wherever, the Quality plan calls for witness of Ultrasonic test by BHEL or BHEL's representative, the material shall be offered for UT in proof machined condition as stated above and hard stamping and subsequent stamp transferring by BHEL shall be followed at subsequent stages to ensure trace ability.

v. Gear boxes shall be checked at No load for backlash, tooth contact, noise, temperature rise and vibration as per attached Procedure No. PEM (Q)/001.

vi. Test certificates shall be furnished for verification of Type tests including environmental tests - for electrical and electro-mechanical items. If Type tests for items with similar / identical construction are not available, arrangement shall be made to conduct the same in the presence of BHEL/ Customer's representative (as required).

vii. Acceptance and routine tests (HV and insulation) for all electrical and electro-mechanical components and system as per governing specification

FINAL INSPECTION OF CRANES- (TESTING OF CRANES AT SUPPLIER'S WORKS)

Cranes shall be completely assembled at manufacturer's works to check the misalignment of gears, shafts and other items. Gears shall be run idle for at least 4 (four) hours. Following minimum tests shall be conducted on the crane at the works of the manufacturer:

a) Deflection test of bridge girder at rated load. Crane shall rest on centerline of LT wheels.

b) Load test and Overload test (running of CT and Hoisting mechanism at 125% of the rated load). Capability of crane to lift the overload from mid-air shall be demonstrated.

c) Electrical tests for brakes, panel, electrical equipment etc. as per IS - 3177

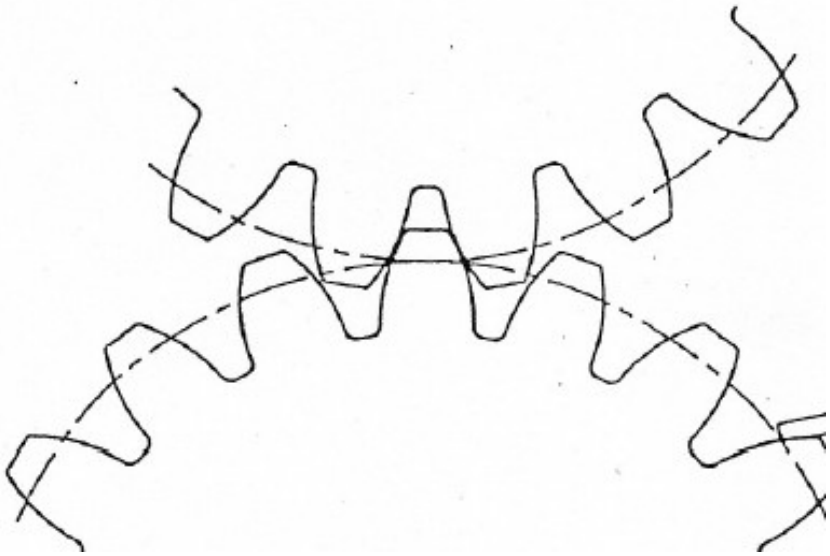
d) All Other tests as per IS-3177.

Procedure No. PEM (Q)/001

SHOP TEST PROCEDURE FOR GEAR BOX

1.0.0	**Scope: Acceptance Norms for Crane Gear Boxes**
1.1.0	This procedure lays down the Acceptance norms for the Gear boxes for EOT crane. This standard also covers vertical gear boxes. Reduction Gears shall be tested for reduction ratio, backlash & contact pattern. Gear Box shall also be subjected to No load run test to check for oil leakage, temp. rise, noise and vibration.
2.0.0	The following dimensions shall be checked:
2.1.0	i. Diameter and keyway dimensions of input and output shafts. ii. Projection of input and output shafts beyond foundation holes and Centre lines of gear box. iii. Centre distance between input and output shafts. iv. Centre Height. v. Distance between foundation holes with respect to center line of the output shaft and distance of foundation holes from center line of the gearbox. vi. Overall dimensions
3.0.0	**Backlash**
3.1.0	The back lash shall be checked by dial gauge preferably (refer Figure –1). Lead wire may be also be used but final decision in case of dispute shall be taken by using dial gauge. The backlash shall be within the limits specified in the drawing. If the value of the backlash allowed is not specified in the drawing, the allowed backlash shall be a given in Table-1
4.0.0	**Area of Contact:**
4.1.0	Area of contact shall be taken by applying Prussian blue. The contact area shall be within the limits mentioned below (refer Figure –2) For final stage of Hoist gearing: h / H shall be more than 30% (a – c) / b shall be more than 40% For all other gears: h / H shall be more than 40% (a – c) / b shall be more than 50%
5.0.0	Running Test
5.1.0	1.1.1 The gear boxes shall be run under no-load condition at the rated speed for minimum four hours in each direction and the following are to be checked: i. All bolts at the joints remain tight

	ii. All gear mesh lines are getting enough lubrication iii. All bearings are getting enough lubrication iv. Bearing temperatures after running for four hours shall not exceed 50 deg. Centigrade or 15 deg. centigrade above ambient whichever is higher. Temperature shall be checked after every hour. v. Vibration: Maximum limit 125 microns (peak to peak) vi. Sound: The gearbox shall not emit unusual sound as obtained under conditions of hard meshing, high spots etc. Maximum sound level shall be 85 dBA at a distance of 1000mm and 91 dBA at a distance of 300 mm. vii. There shall be no Oil leakage at parting lines, bearing housings or inspection covers.
6.0.0	1.1.2 General
6.1.0	1.1.3 In addition to the above specific points, the following general points shall be ensured: i. Inspection pockets are provided as required. ii. Gear box casings are provided with at least two fit bolts/dowels at the parting line. iii. Dip sticks with minimum / maximum level markings are provided. iv. Drain plugs are provided at convenient locations preferably at vertical wall of the housing. v. Breathers are provided. vi. Lifting lugs or eye bolts ar provided as required. vii. Wherever bearings have splash lubrication, oil retainers are provided. viii. Gear boxes are painted as per specification outside and inside. Inside surfaces shall be painted with Oil proof paint. ix. In case of vertical gear boxes having more than two stage reduction, forced lubrication is also provided. 1.1.4 Name plate should provide information eg. Ratio, KW rating, Bearing details and manufacturers name.



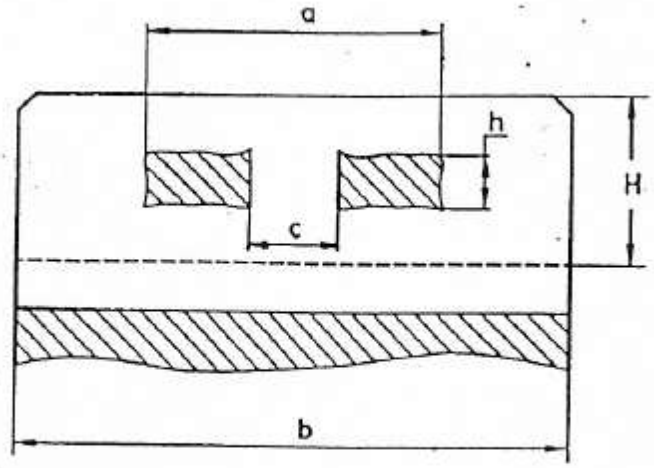


FIG.2 AREA OF CONTACT OF GEAR TEETH

TABLE 1

BACKLASH AND GEARING SPECIFIED BY MODULE

(Clause 3.1.0)

Centre distance in mm		**Tolerances in microns**		
Above	**Up to**	**Minimum**	**Maximum**	
			For gears other than Drum gears	**For Drum gears**
			For all modules 1 to 50	**For all modules 2.5 to 50**
-	50	85	240	280
50	80	105	320	380
80	120	130	360	420
120	200	170	470	530
200	320	210	540	640
320	500	260	660	740
500	800	340	820	880
800	1250	420	970	1040
1250	2000	530	1200	1280
2000	3150	710	1500	1670
3150	5000	850	1810	1980

ANNEXURE

QUALITY ASSURANCE PLAN

000049

QUALITY ASSURANCE PLAN 48 MW CHANJU-III H.E.P

INDEX

000050

QUALITY ASSURANCE PLAN (MODEL)

PROJECT :Chanju-III HEP | **CLIENT: H.P POWER CORPORATION LTD.**
NAME OF EQUIPMENT : EOT Crane | **VENDOR:** | **NIT/P.O. REFERENCE:**

Sl. NO.	ITEM /COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	Referance Documents/ Acceptance Norms	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
1	**Raw Material**								
1.1	Structural Steel (Box Girder, End Trucks, Trolly, Rails etc.)	Chemical Analysis	Sample/Batch	Tech Specn/Appd. Drg./IS	TC	2/3	-	1	TC
		Mech. Properties	-do-	-do-	TC	2/3	-	1	TC
		Ultasonic Test	100%	-do-	TC	2/3	-	1	TC
1.2	Cast/Forged Steel (Wheels, Shafts, Pins,Gears, Pinions, Brake Drum , Couplings, Hook etc.)	Chemical Analysis	Sample/Lot	-do-	TC	2/3	-	1	TC
		Mech. Properties	-do-	-do-	TC	2/3	-	1	TC
		Ultasonic Test	100%	-do-	TC	2/3	-	1	TC
1.3	**Bought Out Items**								
a)	Bushes, Bearings, Pulleys, Fasteners etc.	Material Properties	Sample/Lot	-do-	TC	2/3	-	1	TC
b)	Drive Motor, Gear Box, Plummer Block, EHT Brakes, EM Beakes, Wire Rope, Electrical Cables	Routine Test	100%	-do-	TC	2/3	-	1	TC
2	**In Process Stage**								
2.1	NDT-Welding Fillet Welds	MPI/DPT	-do-	-do-	TC	2/3	-	1	TC
2.2	NDT-Butt Welds (Box Girder, Rope Drums and other full strength welds)	X-RAY/UT	100%	Tech Specn/Appd. Drg./IS	TC	2/3	-	1	TC
2.3	Post Weld Heat Treatment (Fabricated Rope Drums, Gear Box Housing, Forged Crane hooks)	Heat Treatment Chart	-do-	-do-	TC	2/3	-	1	TC

Note: a. In 'Inspection Agency' column figure 1,2, 3 or 4 to be filled. 1- will indicate 'HPPCL', 2- will indicate 'supplier' , 3- will indicate 'sub-supplier' & 4 will indicate 'TPI'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.
d. CHP's shall be jointly done by HPPCL & TPI, and all reports TC shall be jointly checked by HPPCL & TPI

Signature
HPPCL (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

PROJECT :Chanju-III HEP | **CLIENT: H.P POWER CORPORATION LTD.**
NAME OF EQUIPMENT : EOT Crane | **VENDOR: NIT/P.O. REFERENCE:**

Sl. NO.	ITEM /COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	Reference Documents/ Acceptance Norms	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
2.4	**Machining**								
a)	Surface Finish (Rope drum shaft, Rope Drum grooves, Brake Drum)	Visual / Measurement	-do-	-do-	TC	2/3	-	1	TC
b)	Dimensions	Measurement	-do-	-do-	IR	2/3	-	1	RR
2.5	**Sub-Assembly Stage-**Drive Mechanism, Hoist / Trolly arrangements, Brakes								
a)	Alignment/Layout	Visual / Measurement	-do-	-do-	IR	2/3	-	1	RR
b)	Fitment and Clearance	-do-	-do-	-do-	IR	2/3	-	1	RR
c)	Dimensional check	-do-	-do-	-do-	IR	2/3	-	1	RR
d)	Running Performance (Drive Motors, Gear Boxes)-Noise level, Vibration, Temp. rise Leakage Test - Gear Boxes	Visual / Measurement	-do-	-do-	TC	2/3	-	1	TC
e)	Crane Hook-Proof Load Test	Load Test	-do-	-do-	TC	2/3	-	1	TC
f)	NDT-after Proof Load Test Butt Welds (Box Girder, Rope Drums and other full strength welds)	DPT/MPI	-do-	-do-	TC	2/3	-	1	TC
3	**Final inspection/Tests on assembled Crane at manufacturer's works:-**								
3.1 a)	Radiography Examination of Welding	Visual	10%	Tech specn/Appd Drg/IS	IR	2/3	1&4	-	CHP
b)	Welding- NDT	DPT/Magnetic particles	100%	Tech specn/Appd Drg/IS	IR	2/3	1&4	-	CHP
c)	Healthiness of welded portion at shop	Visual	100%		IR	2/3	1&4	-	CHP

Note: a. In 'Inspection Agency'column figure 1,2, 3 or 4 to be filled. 1- will indicate 'HPPCL', 2- will indicate 'supplier' , 3- will indicate 'sub-supplier' & 4 will indicate 'TPI'.
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Signature
HPPCL (QA&I DEPT.)

Signature& Seal
(VENDORS Q.C.DEPT. OR REPRESENTATIVE)

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QUALITY ASSURANCE PLAN (MODEL)

PROJECT :Chanju-III HEP
NAME OF
EQUIPMENT : EOT Crane

CLIENT: H.P POWER CORPORATION LTD.
VENDOR:

NIT/P.O. REFERENCE:

Sl. NO.	ITEM /COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	Referance Documents/ Acceptance Norms	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
3.2	Dimensional check on assembled crane - bridge structure (Box girders, end trucks) hoisting trolly frame, travelling mechanism	measurement	100%	Tech specn/apprd drg./IEC/ Inspection Protocol	TC	2/3	1&4	-	CHP
3.3	Crane Girder Camber	-do-	-do-	Tech. Specn./Apprd drg.	TC	2/3	1&4	-	CHP
3.4	Deflection test at full load/ Rated load	-do-	1/type	Tech. Specn./Apprd drg. /IS: 3177/IEC	JIR	2/3	1&4	-	CHP
4	**Operational/functional test with original control panels**								
4.1	Hoisting and CT Speeds - without load	measurement	1/type	-do-	JIR	2/3	1&4	-	
4.2	Hoisting and CT Speeds at Rated load	-do-	-do-	Tech. Specn./Apprd drg. /IS: 3177/IEC	JIR	2/3	1&4	-	
4.3	Function of brakes for trolly and hoistings	visual	-do-	Tech. Specn./Apprd drg. /IS: 3177/IEC	JIR	2/3	1&4	-	CHP
4.4	Amperage at no load and full load for all motors	measurement	-do-	-do-	JIR	2/3	1&4	-	
4.5	Creeping speed/ Jog movement with rated load	visual / measurement	-do-	Tech. Specn./Apprd drg. /IS: 3177/IEC	JIR	2/3	1&4	-	
4.6	Over Load Test at 125% of rated load	visual / measurement	-do-	Tech. Specn./Apprd drg. /IS: 3177/IEC	JIR	2/3	1&4	-	
4.7	Hardness and tensile stress test on hooks, steel plates and steel sections of the main girders of the ridge and trolley	measurement	Sample of each delivery	Tech. Specn./Apprd drg. /IEC	JIR	2/3	1&4	-	
4.8	Sand blasting & Painting	visual / measurement	-do-	Painting Protocol/ IS	TC	2/3	-	1	TC
4.8	**Control Panel (At Supplier's Premises)**								
a)	Resisters, Capacitors, Limit Switches, Master Controllers, Thyristers, VVVF Modules, Transformers, Circuit Breakers, Switches etc.	Electrical	100%	Tech specn/apprd drg./IEC	TC	2/3	-	1	TC

Note: a. In 'Inspection Agency'column figure 1,2, 3 or 4 to be filled. 1- will indicate 'HPPCL', 2- will indicate 'supplier' , 3- will indicate 'sub-supplier' & 4 will indicate 'TPI'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.
d. CHP's shall be jointly done by HPPCL & TPI, and all reports/TC shall be jointly checked by HPPCL & TPI

Signature
HPPCL (QA&I DEPT.)

Signature& Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

PROJECT :Chanju-III HEP | **CLIENT: H.P POWER CORPORATION LTD.**
NAME OF EQUIPMENT : EOT Crane | **VENDOR :**
NIT/P.O. REFERENCE:

Sl. NO.	ITEM /COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	Referance Documents/ Acceptance Norms	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
a)	Verification of scheme, make and rating of componenets	visual	1/type	Tech specn/apprd drg./IEC	JIR	2/3	1&4	-	
b)	Cubicle Dimensions	Measurement	-do-	apprd drg.	JIR	2/3	1&4	-	
c)	Functional check including HV and IR tests	Electrical	-do-	Tech specn/apprd drg./IEC	JIR	2/3	1&4	-	CHP
d)	Sequence of operation and interlock tests	-do-	-do-	Tech specn/apprd drg./IEC	JIR	2/3	1&4	-	
e)	Single phase protection	-do-	-do-	Tech. Specn./Apprd drg. /IS: 3177/IEC	JIR	2/3	1&4	-	
h)	Instantaneous over current protection	-do-	-do-	Tech. Specn./Apprd drg. /IS: 3177/IEC	TC	2/3	-	1	TC
g)	Thermal overload relay	-do-	-do-	Tech. Specn./Apprd drg. /IS: 3177/IEC	TC	2/3	-	1	TC
h)	Undervoltage protection	-do-	-do-	Tech. Specn./Apprd drg. /IS: 3177/IEC	TC	2/3	-	1	TC
4.9	Radio control tests of speed control of bridge travel, trolly travel & hoist motion, control of master contactor, indication and alarm (if applicable)	Functional test	-do-	Tech. Specn./Apprd drg. /IS: 3177/IEC	JIR	2/3	1&4	-	
4.10	Pendant control test (ifapplicable)	Electrical	-do-	Tech. Specn./Apprd drg. /IS: 3177/IEC	JIR	2/3	1&4	-	CHP

Note: a. In 'Inspection Agency'column figure 1,2, 3 or 4 to be filled. 1- will indicate 'HPPCL', 2- will indicate 'supplier' , 3- will indicate 'sub-supplier' & 4 will indicate 'TPI'.
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QUALITY ASSURANCE PLAN (MODEL)

PROJECT :Chanju-III HEP
NAME OF
EQUIPMENT : 415 V, AC Switchgear

CLIENT: Himachal Pradesh Power Corporation Ltd.
VENDOR :
NIT/P.O. REFERENCE:

SR. NO.	ITEM /COMPONENTS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
1	**Raw Material & Brought Out Items**								
1.1	**Steel Sheets**								
a)	Dimension Size of Sheet, Uniformity of Thickness, Surface Finish.)	Measurement	As per sampling plan	Tech. Spec./ Appd.drg./ IS:513	TC	2/3	-	1	TC
1.2	**Copper/ Copper Alloy flats for Bus-bars & Links.**								
a)	Dimension	Measurement	-do-	Tech. Spec./ Appd.drg./ IS:613	TC	2/3	-	1	TC
b)	Bend Test	Mechanical	-do-	Tech. Spec./ Appd.drg./ IS:191	TC	2/3	-	1	TC
c)	Hardness	-do-	-do-	-do-	TC	2/3	-	1	TC
d)	Tensile Strength	-do-	-do-	Tech. Spec./ Appd.drg./IS:1897	TC	2/3	-	1	TC
e)	Chemical Composition.	Chemical	-do-	Tech. Spec./ Appd.drg./IS:6160	TC	2/3	-	1	TC
f)	Conductivity	Electrical	-do-	Tech. Spec./ Appd.drg.	TC	2/3	-	1	TC
1.3	**PVC Wire**								
a)	Dimension	Measurement	-do-	Tech. Spec./ Appd.drg./ IS:694	TC	2/3	-	1	TC
b)	Insulation Resistance	Electrical	-do-	-do-	TC	2/3	-	1	TC
c)	Conductor Resistance	Electrical	-do-	-do-	TC	2/3	-	1	TC
d)	Material Properties: (Annealing, TS, Thickness of Insulation & Sheath, etc.)	Mechanical	-do-	-do-	TC	2/3	-	1	TC

Note: a. In 'Inspection Agency'column figure 1,2, 3 or 4 to be filled. 1- will indicate 'HPPCL', 2- will indicate 'supplier' , 3- will indicate 'sub-supplier' & 4 will indicate 'TPI'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.
d. CHP's shall be jointly done by HPPCL & TPI, and all reports/TC shall be jointly checked by HPPCL & TPI

Signature
H.P.P.C.L (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

PROJECT :Chanju-III HEP
NAME OF
EQUIPMENT : 415 V, AC Switchgear

CLIENT: Himachal Pradesh Power Corporation Ltd.
VENDOR :
NIT/P.O. REFERENCE:

SR. NO.	ITEM /COMPONENTS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
1.4	**Electrical Meters (Ammeter, Voltmeter, Freq. meter etc.)**								
a)	Physical condition	Visual	100%	Tech. Spec./ Appd.drg./IS:1248	TC	2/3	-	1	TC
b)	Verification of Scale & Range.	Electrical	-do-	-do-	TC	2/3	-	1	TC
c)	Calibration Test	Verification	-do-	-do-	TC	2/3	-	1	TC
1.5	**Current Transformer**								
a)	Make, Type & Rating	Visual	100%	Tech.Spec./Appd.drg./IEC:44	TC	3/2	-	1	TC
b)	Routine Test	Test	100%	-do-	TC	3/2	-	1	TC
1.6	**Voltage Transformer**								
a)	Make, Type & Rating	Visual	100%	Tech. Spec./Appd.drg./IEC:186	TC	3/2	-	1	TC
b)	Routine Test	Test	100%	-do-	TC	3/2	-	1	TC
1.7	**MCCB / MCB**								
a)	Make, Type & Rating	Visual	100%	Tech. Spec./Appd.drg./IS:8828	TC	3/2	-	1	TC
b)	Operational Test	Electrical	-do-	-do-	TC	3/2	-	1	TC
1.8	**Overload Relay**								
a)	Make, Type & Rating	Visual	100%	Tech. Spec./ Appd.drg./IS:8544	TC	2/3	-	1	TC
b)	Operational Test	Electrical	-do-	-do-	TC	2/3	-	1	TC

Note: a. In 'Inspection Agency'column figure 1,2, 3 or 4 to be filled. 1- will indicate 'HPPCL', 2- will indicate 'supplier' , 3- will indicate 'sub-supplier' & 4 will indicate 'TPI'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.
d. CHP's shall be jointly done by HPPCL & TPI, and all reports/TC shall be jointly checked by HPPCL & TPI

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H.P.P.C.L (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

PROJECT :Chanju-III HEP
NAME OF EQUIPMENT : 415 V, AC Switchgear

CLIENT: Himachal Pradesh Power Corporation Ltd.
VENDOR :
NIT/P.O. REFERENCE:

SR. NO.	ITEM /COMPONENTS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
1.9	**Power & Auxiliary Contactor**								
a)	Make, Type & Rating	Visual	100%	Tech. Spec./ Appd.drg./IS:2959	TC	2/3	-	1	TC
b)	Operational Test	Electrical	-do-	-do-	TC	2/3	-	1	TC
1.10	**Bimetallic Overload Relays**								
a)	Make, Type & Rating	Visual	100%	Tech. Spec./ Appd.drg./IS:8544	TC	2/3	-	1	TC
b)	Operational Test	Electrical	-do-	-do-	TC	2/3	-	1	TC
1.11	**Timers (Electronics & Electro -pneumatic & Annunciaters)**								
a)	Time limits	Electrical	100%	Tech. Spec./ Appd.drg./ IS Code	TC	2/3	-	1	TC
b)	Operation	-do-	-do-	-do-	TC	2/3	-	1	TC
1.12	**Switches & Control Switches**								
a)	Breakage	Visual	100%	Tech. Spec./ Appd.drg./ IS:4064 & IS:6875	TC	2/3	-	1	TC
b)	Rating	Visual	-do-	-do-	TC	2/3	-	1	TC
c)	Operation	Electrical	-do-	-do-	TC	2/3	-	1	TC

Note: a. In 'Inspection Agency'column figure 1,2, 3 or 4 to be filled. 1- will indicate 'HPPCL', 2- will indicate 'supplier' , 3- will indicate 'sub-supplier' & 4 will indicate 'TPI'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
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Signature
H.P.P.C.L (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

PROJECT :Chanju-III HEP
NAME OF
EQUIPMENT : 415 V, AC Switchgear

CLIENT: Himachal Pradesh Power Corporation Ltd.
VENDOR :
NIT/P.O. REFERENCE:

SR. NO.	ITEM /COMPONENTS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
1.13	**ACB**								
a)	Routine test	Electrical	100%	Tech.Spec./Appd.drg./IS:13947	TC	2/3	-	1	TC
2	**Final Inspection**								
2.1	**Mechanical Checks**								
a)	BOM verification	Visual	100%	Tech.Spec./Appd.drg./IEC:Code	JIR	2/3	1 & 4	-	
b)	Layout checking and Accessibility	Visual	-do	-do	JIR	2/3	1 & 4	-	
c)	Dimensional checks (Sheet thickness, Paint thickness, Paint shade& overall dimension)	Measurement	-do	-do	JIR	2/3	1 & 4	-	
d)	Name plate details	Visual	-do	-do	JIR	2/3	1 & 4	-	
e)	Mechanical operation of equipments.	Mechanical	-do	-do	JIR	2/3	1 & 4	-	CHP
2.2	**Electrical Checks**								
a)	Electrical operation of equipments Verification of the short-circuit strength, continuity of protective circuit Short duration power freq. voltage test Voltage tests on auxiliary circuits	Electrical	-do	-do	JIR	2/3	1 & 4	-	
b)	Scheme checking	-do	-do	-do	JIR	2/3	1 & 4	-	
c)	IR Test before & after HV Test	-do	-do	-do	JIR	2/3	1 & 4	-	
d)	HV Test	-do	-do	-do	JIR	2/3	1 & 4	-	
2.3	**Other Checks**								
a)	Verification of the degree of protection according to IEC 529	Measurement	-do	-do	TC	2/3			TC
b)	Verification of Temp.rise limits								
c)	Dielectric Properties test								

Note: a. In 'Inspection Agency'column figure 1,2, 3 or 4 to be filled. 1- will indicate 'HPPCL', 2- will indicate 'supplier' , 3- will indicate 'sub-supplier' & 4 will indicate 'TPI'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
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Signature
H.P.P.C.L (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

PROJECT : Chanju-III HEP | **CLIENT: H.P POWER CORPORATION LTD.**
NAME OF | **VENDOR :**
EQUIPMENT : 11 kV XLPE Cable | **NIT/P.O. REFERENCE :**

SR. NO.	ITEM /COMPONENTS/ CHRACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
1	**Raw Material and Bought Out Items**								
1.1	**Aluminium Rods**								
a)	Diameter	Measurement	100% Coils	Tech. Spec./ IS:5484 & 1753	TC	2/3	-	1	TC
b)	Resistivity	Electrical	Sample plan	Tech. Spec./ IS:5484	TC	2/3	-	1	TC
c)	T.S. and E.B.	Mechanical	-do-	-do-	TC	2/3	-	1	TC
d)	Chemical Composition	Chemical	-do-	Tech. Spec./ IS:1753	TC	2/3	-	1	TC
e)	Surface Finish	Visual	-do-	Tech. Spec./ IS:5484	TC	2/3	-	1	TC
1.2	**Copper Conductor**								
a)	Diameter	Measurement	100% Drum	Tech.Spec./ IS:8130,613 & 2982	TC	3/2	-	1	TC
b)	No. of Strands	Count.	-do-	-do-	TC	3/2	-	1	TC
c)	DC Resistance	Electrical	-do-	-do-	TC	3/2	-	1	TC
d)	Lay Direction	Visual	-do-	-do-	TC	3/2	-	1	TC
e)	Resistivity	Electrical	-do-	-do-	TC	3/2	-	1	TC
f)	T.S. & E.B.	Mechanical	-do-	-do-	TC	3/2	-	1	TC
g)	Chemical Composition.	Chemical	-do-	Tech.Spec./ IS:191	TC	3/2	-	1	TC
1.3	**PVC Compound**								
a)	Specific Gravity	Measurement	1Bag/Consign	Tech. Spec. & IEC:540	TC	2/3	-	1	TC
b)	T.S. & E.B. before and after Ageing	Mechanical	-do-	Tech. Spec./ IS:5831	TC	2/3	-	1	
c)	Loss of mass	Thermal.	-do-	-do-	TC	2/3	-	1	TC
d)	Thermal Stability	-do-	-do-	-do-	TC	2/3	-	1	TC
e)	Oxygen Index	Envi.	-do-	Tech. Spec./ IS:7098 part-1	TC	2/3	-	1	TC
f)	Temperature Index	Envi.	-do-	-do-	TC	2/3	-	1	TC

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b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
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Signature
HPPCL (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

PROJECT : Chanju-III HEP **CLIENT: H.P POWER CORPORATION LTD.**
NAME OF **VENDOR :**
EQUIPMENT : 11 kV XLPE Cable **NIT/P.O. REFERENCE :**

SR. NO.	ITEM /COMPONENTS/ CHRACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
g)	Acid Gas Generation Test	Chemical	-do-	Tech. Spec./ IS:7098 part-1/ IEC	TC	2/3	-	1	TC
h)	Smoke Density Test	Envi.	-do-	Tech. Spec./ ASTM D2843-93	TC	2/3	-	1	TC
I)	Anti Termite & Anti Rodent Test	Chemical	-do-	Tech. Spec./ IS	TC	2/3	-	1	TC
1.4	**Copper Tape**								
a)	Dimension	Measurement	Sampling Plan	Tech. Spec./ IS	TC	2/3	-	1	TC
b)	Tensile & Elongation	Mechanical	-do-	-do-	TC	2/3	-	1	TC
c)	Resistivity	Electrical	-do-	-do-	TC	2/3	-	1	TC
d)	Surface Finish	Visual	-do-	-do-	TC	2/3	-	1	TC
e)	ID/OD of coil	Measurement	-do-	-do-	TC	2/3	-	1	TC
1.5	**Armour Wire /Strip**								
a)	T.S.& E.B.	Mechanical	-do-	Tech. Spec./ IS:3975	TC	2/3	-	1	TC
b)	Torsion	-do-	-do-	-do-	TC	2/3	-	1	TC
c)	Dip Test	-do-	-do-	-do-	TC	2/3	-	1	TC
d)	Mass of Zinc Coating	-do-	-do-	-do-	TC	2/3	-	1	TC
e)	Resistivity	Mechanical	-do-	-do-	TC	2/3	-	1	TC
f)	Dimension	Measurement	-do-	-do-	TC	2/3	-	1	TC
g)	Winding Test	'Physical.	Sampling Plan	-do-	TC	2/3	-	1	TC
h)	Weight of Coil	Measurement	-do-	-do-	TC	2/3	-	1	TC

Note: a. In 'Inspection Agency'column figure 1,2, 3 or 4 to be filled. 1- will indicate 'HPPCL', 2- will indicate 'supplier' , 3- will indicate 'sub-supplier' & 4 will indicate 'TPI'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.
d. CHP's shall be jointly done by HPPCL & TPI, and all reports/TC shall be jointly checked by HPPCL & TPI

Signature
HPPCL (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

PROJECT : Chanju-III HEP | **CLIENT: H.P POWER CORPORATION LTD.**
NAME OF | **VENDOR :**
EQUIPMENT : 11 kV XLPE Cable | **NIT/P.O. REFERENCE :**

SR. NO.	ITEM /COMPONENTS/ CHRACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY Perform	Witness	Verify	REMARKS
1.6	**XLPE Compound**								
a)	Sp. Gravity	Measurement	1 Box	Tech. Spec & IEC :540	TC	2/3	-	1	TC
b)	Tensile & Elongation before & after	Measurement	-do-	-do-	TC	2/3	-	1	TC
c)	Volume Resistivity	Measurement	-do-	-do-	TC	2/3	-	1	TC
d)	Moisture Content Test	Thermal	-do-	-do-	TC	2/3	-	1	TC
1.7	**Semi Conducting Compound**								
	Sp. Gravity	Measurement	1 box/Consign	-do-	TC	2/3	-	1	TC
2	**Final Inspection**								
2.1	**Acceptance Test**								
a)	Annealing Test (For Cu)	Mechanical	One lot/size	Tech.Spec./IS:1554, 8130,10810	JIR	2/3	1&4	-	CHP
b)	Tensile Test (For Al)	-do-	-do-	-do-	JIR	2/3	1&4	-	CHP
c)	Wrapping Test (For Al)	-do-	-do-	-do-	JIR	2/3	1&4	-	CHP
d)	Conductor Resistance Test	Electrical	-do-	Tech.Spec./IS:2982,10810	JIR	2/3	1&4	-	CHP
e)	Tests for thickness of Insulation & Sheath	Measurement	-do-	Tech.Spec./IS:1554 Part-1,10810	JIR	2/3	1&4	-	CHP
f)	T.S. & E.B. of Insulation & Sheath	Mechanical	-do-	-do-	JIR	2/3	1&4	-	CHP
g)	Hot Set Test for Insulation.	-do-	-do-	Tech.Spec./IS: 7098 Part-	JIR	2/3	1&4	-	CHP
h)	Insulation Resistance Test	Electrical	-do-	Tech.Spec./IS:5831,10810	JIR	2/3	1&4	-	CHP
i)	High Voltage Test (At Room Temp. & cable immersed water)	-do-	-do-	Tech.Spec./IS:7098 part-2,10810	JIR	2/3	1&4	-	CHP
j)	Partial Discharge Test (for Screened	-do-	-do-	Tech.Spec./IS:7098 part-2 &	JIR	2/3	1&4	-	CHP

Note: a. In 'Inspection Agency'column figure 1,2, 3 or 4 to be filled. 1- will indicate 'HPPCL', 2- will indicate 'supplier' , 3- will indicate 'sub-supplier' & 4 will indicate 'TPI'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.
d. CHP's shall be jointly done by HPPCL & TPI, and all reports/TC shall be jointly checked by HPPCL & TPI

Signature
HPPCL (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

PROJECT : Chanju-III HEP **CLIENT: H.P POWER CORPORATION LTD.**
NAME OF **VENDOR :**
EQUIPMENT : 11 kV XLPE Cable **NIT/P.O. REFERENCE :**

SR. NO.	ITEM /COMPONENTS/ CHRACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
2.2	**Routine Tests**								
a)	Conductor Resistance Test	-do-	100%	Tech.Spec./IS:2982,10810	TC	2/3	-	1	TC
b)	High Voltage Test (At Room Temp.)	-do-	-do-	Tech.Spec./IS:7098 part-	TC	2/3	-	1	TC
c)	Partial discharge test(for Screened only)	-do-	-do-	Tech.Spec./IS:7098 part-2 &	TC	2/3	-	1	TC
2.3	**FRLS Tests**								
a)	HCL Gas Generation Test	Chem.	One lot/size	Tech.Spec./IS:7098 part-1	JIR	2/3	1&4	-	CHP
b)	Oxygen Index Test	Thermal	-do-	-do-	JIR	2/3	1&4	-	CHP
c)	Temperature Index Test	-do-	-do-	-do-	JIR	2/3	1&4	-	CHP
d)	Smoke Density Test	-do-	-do-	Tech.Spec./ASTM D 2843	JIR	2/3	1&4	-	CHP
e)	Flammability Test	Flam.	-do-	Tech.Spec./IS:1554	JIR	2/3	1&4	-	CHP
f)	Swidish chimney Test	-do-	-do-	Tech.Spec./SS-424 14 75	JIR	2/3	1&4	-	CHP
g)	Ladder Test	-do-	-do-	Tech.Spec./IEEE-383	JIR	2/3	1&4	-	CHP
h)	Heat Shock Test	Ther.	-do-	Tech.Spec./IS:1554 & 10810	JIR	2/3	1&4	-	CHP
i)	Anti Rodent & Termite Test	Chem.	-do-	Tech spec	JIR	2/3	1&4	-	CHP
2.4	**Check for Embossing and Colour**	Visual	-do-	Tech.Spec./Appd.drg./ IS 7098 part-2	JIR	2/3	1&4	-	CHP
2.5	**Packing, Marking & End Sealing**								
a)	Marking on Cable Drum	Visual	Each Drum	-do-	TC	2/3	-	1	TC
b)	End Sealing	-do-	One lot/size	-do-	JIR	2/3	-	1	TC

Note: a. In 'Inspection Agency'column figure 1,2, 3 or 4 to be filled. 1- will indicate 'HPPCL', 2- will indicate 'supplier' , 3- will indicate 'sub-supplier' & 4 will indicate 'TPI'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.
d. CHP's shall be jointly done by HPPCL & TPI, and all reports/TC shall be jointly checked by HPPCL & TPI

000184

Signature
HPPCL (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

PROJECT : Chanju-III HEP | **CLIENT: H.P POWER CORPORATION LTD.**

NAME OF EQUIPMENT : Power, Control & Instr. Cable | **VENDOR : NIT/P.O. REFERENCE :**

SR. NO.	ITEM /COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
1	**Raw Material and Bought Out items**								
1.1	**Aluminium Rods**								
a)	Diameter	Measurement	100% Coils	Tech. Spec./ IS:5484	TC	3/2	-	1	TC
b)	Resistivity	Electrical	Sample plan	-do-	TC	3/2	-	1	TC
c)	T.S. and E.B.	Mechnical	-do-	-do-	TC	3/2	-	1	TC
d)	Chemical Composition	Chemical	-do-	Tech. Spec./ IS:1753	TC	3/2	-	1	TC
e)	Surface Finish	Visual	-do-	Tech. Spec./ IS:5484	TC	3/2	-	1	TC
1.2	**PVC Compound**								
a)	Sp. Gravity	Measurement	1 Bag/Consgn.	Tech. Spec./ IEC:540	TC	3/2	-	1	TC
b)	T.S. & E.B. Before and After Ageing	Mechanical	-do-	Tech. Spec./ IS:5831	TC	3/2	-	1	TC
c)	Loss of Mass	Therm.	-do-	-do-	TC	3/2	-	1	TC
d)	Thermal Stability	Therm.	-do-	-do-	TC	3/2	-	1	TC
e)	Oxygen Index	Envi.	-do-	Tech. Spec./ IS:7098 part-1	TC	3/2	-	1	TC
f)	Temperature Index	Envi.	-do-	-do-	TC	3/2	-	1	TC
g)	Acid Gas Generation Test	Chem.	-do-	Tech. Spec./ IEC:754-1/ IS:7098 part-1	TC	3/2	-	1	TC
h)	Smoke density Test	Envi.	-do-	Tech. Spec./ ASTM D2843-93	TC	3/2	-	1	TC
i)	Anti Termite & Anti Rodent Test	Chem.	-do-	Tech. Spec./ IS	TC	3/2	-	1	TC

Note: a. In 'Inspection Agency'column figure 1,2, 3 or 4 to be filled. 1- will indicate 'HPPCL', 2- will indicate 'supplier' , 3- will indicate 'sub-supplier' & 4 will indicate 'TPI'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.
d. CHP's shall be jointly done by HPPCL & TPI, and all reports/TC shall be jointly checked by HPPCL & TPI

Signature
HPPCL (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

000185

QUALITY ASSURANCE PLAN (MODEL)

PROJECT : Chanju-III HEP | **CLIENT: H.P POWER CORPORATION LTD.**

NAME OF EQUIPMENT : Power, Control & Instr. Cable | **VENDOR : NIT/P.O. REFERENCE :**

SR. NO.	ITEM /COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
1.3	**Galvanised Steel Wires & Strips.**								
a)	Dimension	Measurement	Sample plan	Tech.Spec./ IS:3975 & 3979	TC	3/2	-	1	TC
b)	Resistivity	Electrical	-do-	-do-	TC	3/2	-	1	TC
c)	T.S. and E.B.	Mechanical	-do-	-do-	TC	3/2	-	1	TC
d)	Uniformity Test	-do-	-do-	-do-	TC	3/2	-	1	TC
e)	Wt.of Zinc Coating	-do-	-do-	-do-	TC	3/2	-	1	TC
f)	Torsion Test.	-do-	-do-	-do-	TC	3/2	-	1	TC
1.4	**Copper Conductor**								
a)	Diameter	Measurement	100% Drum	Tech.Spec./ IS:8130,613 & 2982	TC	3/2	-	1	TC
b)	No. of Strands	Count.	-do-	-do-	TC	3/2	-	1	TC
c)	DC Resistance	Electrical	-do-	-do-	TC	3/2	-	1	TC
d)	Lay Direction	Visual	-do-	-do-	TC	3/2	-	1	TC
e)	Resistivity	Electrical	-do-	-do-	TC	3/2	-	1	TC
f)	T.S. & E.B.	Mechanical	-do-	-do-	TC	3/2	-	1	TC
g)	Chemical Composition.	Chemical	-do-	Tech.Spec./ IS:191	TC	3/2	-	1	TC

Note: a. In 'Inspection Agency'column figure 1,2, 3 or 4 to be filled. 1- will indicate 'HPPCL', 2- will indicate 'supplier' , 3- will indicate 'sub-supplier' & 4 will indicate 'TPI'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.
d. CHP's shall be jointly done by HPPCL & TPI, and all reports/TC shall be jointly checked by HPPCL & TPI

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HPPCL (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

PROJECT : Chanju-III HEP | **CLIENT: H.P POWER CORPORATION LTD.**

NAME OF EQUIPMENT : Power, Control & Instr. Cable | **VENDOR : NIT/P.O. REFERENCE :**

SR. NO.	ITEM /COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
2	**Final Inspection**								
2.1	**ACCEPTANCE TESTS**								
a)	Annealing Test (For Cu)	Mechanical	One lot/size	Tech. Spec./ IS:8130 & 10810	JIR	2/3	1&4	-	CHP
b)	Tensile Test (For Al)	-do-	-do-	-do-	JIR	2/3	1&4	-	CHP
c)	Wrapping Test (For Al)	-do-	-do-	-do-	JIR	2/3	1&4	-	CHP
d)	T.S. & E.B. of Insulation & Sheath	-do-	-do-	Tech. Spec./ IS:5831,10810	JIR	2/3	1&4	-	CHP
e)	Test for thickness of Insulation and Sheath	-do-	-do-	Tech. Spec./ IS:1554 part-1,10810	JIR	2/3	1&4	-	CHP
f)	Conductor Resistance Test	Electrical	-do-	Tech. Spec./ IS:8130,10810	JIR	2/3	1&4	-	CHP
g)	Insulation Resistance Test	-do-	-do-	Tech. Spec./ IS:7098 part-1, IS: 1554 part-1 ,10810	JIR	2/3	1&4	-	CHP
h)	High Voltage Test (At Room Temp. & cable immersed water)	-do-	-do-	-do-	JIR	2/3	1&4	-	CHP
2.2	**ROUTINE TESTS**								
a)	Conductor Resistance Test	-do-	100%	Tech. Spec./ IS:8130,10810	TC	3/2	-	1	TC
b)	High Voltage Test (At Room (Temp.)	-do-	-do-	Tech. Spec./ IS:7098 part-1, IS: 1554 part-1,10810	TC	3/2	-	1	TC

Note: a. In 'Inspection Agency'column figure 1,2, 3 or 4 to be filled. 1- will indicate 'HPPCL', 2- will indicate 'supplier' , 3- will indicate 'sub-supplier' & 4 will indicate 'TPI'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.
d. CHP's shall be jointly done by HPPCL & TPI, and all reports/TC shall be jointly checked by HPPCL & TPI

Signature
HPPCL (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

PROJECT : Chanju-III HEP | **CLIENT: H.P POWER CORPORATION LTD.**

NAME OF | **VENDOR :**

EQUIPMENT : Power, Control & Instr. Cable | **NIT/P.O. REFERENCE :**

SR. NO.	ITEM /COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
2.3	**FRLS Tests**								
a)	HCL Gas Generation Test	Chem.	One lot/size	Tech.Spec./IS:7098 part-1	JIR	2/3	1&4	-	CHP
b)	Oxygen Index Test	Therm.	-do-	Tech.Spec./ASTM-D-2843/IS 7098 part-1	JIR	2/3	1&4	-	CHP
c)	Temperature Index Test	-do-	-do-	Tech.Spec./IS:7098 part-1	JIR	2/3	1&4	-	CHP
d)	Smoke Density Test	-do-	-do-	Tech.Spec./ASTM-D-2843/IS 7098 part-1	JIR	2/3	1&4	-	CHP
e)	Flammability Test	Flam.	-do-	Tech.Spec./IEC:332-1/IS 1554	JIR	2/3	1&4	-	CHP
f)	Swidish Chimney Test	-do-	-do-	Tech.Spec./SS-424 14 75	JIR	2/3	1&4	-	CHP
g)	Ladder Test	-do-	-do-	Tech.Spec./IEEE-383	JIR	2/3	1&4	-	CHP
h)	Heat Shock Test	Ther.	-do-	Tech.Spec./IS:1554 & 10810	JIR	2/3	1&4	-	CHP
i)	Anti Rodent & Termite Test	Chem.	-do-	Tech. Spec.	JIR	2/3	1&4	-	CHP
					JIR	2/3	1&4	-	CHP
2.4	**Check for Embossing and Colour Coding, etc.**	Visual	-do-	Tech.Spec./IS:7098 part-1	JIR	2/3	1&4	-	CHP
2.5	**Packing, Marking & End Sealing**								
a)	Marking on Cable Drum	Visual	100%	Tech.Spec./IS:7098 part-1	TC	3/2	-	1	TC
b)	End Sealing	Visual	One lot/size	-do-	TC	2/3	-	1	TC

Note: a. In 'Inspection Agency'column figure 1,2, 3 or 4 to be filled. 1- will indicate 'HPPCL', 2- will indicate 'supplier' , 3- will indicate 'sub-supplier' & 4 will indicate 'TPI'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.
d. CHP's shall be jointly done by HPPCL & TPI, and all reports/TC shall be jointly checked by HPPCL & TPI

Signature
HPPCL (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

PROJECT : Chanju-III HEP | **CLIENT: H.P POWER CORPORATION LTD.**
NAME OF | **VENDOR :**
EQUIPMENT : Cable Tray | **NIT/P.O. REFERENCE :**

SR. NO.	ITEM /COMPONENTS & CHRACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
1	**Raw Material & Bought Out Items.**								
1.1	**(MS Sheet/Channel/Angle)**								
a)	Chemical composition	Chem.	Sampling Plan	Tech.Spec./ Appd.drg./IS:1079	TC	3/2	-	1	TC
b)	Physical Properties	Test	-do-	-do-	TC	3/2	-	1	TC
c)	Surface Finish	Visual	-do-	-do-	TC	3/2	-	1	TC
d)	Dimensions	Measurement	-do-	Tech.Spec./ Appd.drg./IS:1852	TC	3/2	-	1	TC
1.2	**Fasteners and Hardwares**								
a)	Visual and Dimensional	Visual & Measurement	-do-	Tech.Spec./ Appd.drg./IS:1367	TC	3/2	-	1	TC
b)	Quantity of Zinc Deposit Over Threaded Portion	Measurement	-do-	-do-	TC	3/2	-	1	TC
2	**In Process Stage**								
2.1	**Galvanising**								
a)	Galvanisation, Chemical Composition of Zinc, Surface Defects, Bath Temperature.	Chem./Visual	Sampling plan	Tech.Spec./ Appd.drg./IS:2629	TC	3/2	-	1	TC
2.2	**Galvanised Trays**								
a)	Surface Defects	Visual	Sampling Plan	-do-	TC	3/2	-	1	TC
b)	Uniformity of Zinc Coating	Test	-do-	Tech.Spec./ Appd drg./IS:2633	TC	3/2	-	1	TC
c)	Thickness of Zinc Coating	Measurement	-do-	Tech.Spec./ Appd drg.	TC	3/2	-	1	TC
d)	Adhesion Test	Physical	-do-	Tech.Spec./ Appd drg./IS:2629	TC	3/2	-	1	TC
e)	Weight of Zinc Coating	Measurement	-do-	Tech.Spec./ Appd drg./IS:6745	TC	3/2	-	1	TC
2.3	**Dichromating**	Visual	-do-	Tech.Spec./ Appd drg.	TC	3/2	-	1	TC

Note: a. In 'Inspection Agency'column figure 1,2, 3 or 4 to be filled. 1- will indicate 'HPPCL', 2- will indicate 'supplier' , 3- will indicate 'sub-supplier' & 4 will indicate 'TPI'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.
d. CHP's shall be jointly done by HPPCL & TPI, and all reports/TC shall be jointly checked by HPPCL & TPI

Signature
HPPCL (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN(MODEL)

PROJECT : Chanju-III HEP | **CLIENT: H.P POWER CORPORATION LTD.**

NAME OF EQUIPMENT : Cable Tray | **VENDOR :** | **NIT/P.O. REFERENCE :**

SR. NO.	ITEM /COMPONENTS & CHRACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
3	**Final Inspection**								
3.1	Dimension/ Finish of Trays & Covers	Measurement & Visual	Sampling Plan	-do-	TC	3/2	-	1	TC
3.2	Load Capacity	Deflection Test	-do-	-do-	TC	3/2	-	1	TC
3.3	Surface defects / Black Spot	Visual	-do-	-do-	TC	3/2	-	1	TC
3.4	Uniformity of Zinc Coating	Test	-do-	Tech.Spec./ Appd drg./IS:2633	TC	3/2	-	1	TC
3.5	Weight of Zinc Coating	Measurement	-do-	Tech.Spec./ Appd drg./IS:6745	TC	3/2	-	1	TC
3.6	Check for Dicromating	Visual	-do-	Tech.Spec./ Appd drg./IS:2629	TC	3/2	-	1	TC
3.7	Thickness of Zinc Coating	Measurement	-do-	Tech.Spec./ Appd drg.	TC	3/2	-	1	TC
3.8	Adhesion Test	Hammer Test	-do-	Tech.Spec./ Appd drg./IS:2629	TC	3/2	-	1	TC

Note: a. In 'Inspection Agency'column figure 1,2, 3 or 4 to be filled. 1- will indicate 'HPPCL', 2- will indicate 'supplier' , 3- will indicate 'sub-supplier' & 4 will indicate 'TPI'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.
d. CHP's shall be jointly done by HPPCL & TPI, and all reports/TC shall be jointly checked by HPPCL & TPI

Signature
HPPCL (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-Q-006, REV-02	DATE: 17.04.2020
	PROJECT:		PO NO.:	DATE:
	ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 of 2

S. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/ N					M	C	N	
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	-	MFG. SPEC.	MFG. SPEC.	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	VISUAL	100%	-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	LOG BOOK		P	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MFG.SPEC./	MFG.SPEC.	LOG BOOK		P	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	-	MFG. SPEC/ APPROVED DATASHEET	MFG. SPEC/ APPROVED DATASHEET	LOG BOOK	✓	P	V	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST	MA	VISUAL	100%	-	IS-325 / IS-12615/ APPROVED DATA SHEET	IS-325 / IS-12615/ APPROVED DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	-	APPROVED DRG/ DATA SHEET	APPROVED DRG/ DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1 & NOTE-2

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-Q-006, REV-02	DATE: 17.04.2020
	PROJECT:		PO NO.:	DATE:
	ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 of 2

		3.NAMEPLATE DETAILS	MA	VISUAL	100%	-	IS-325 / IS-12615 / APPROVED DATA SHEET	SAME AS COL. 7	TEST/ INSPN. REPORT	✓	P	V	-	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MFG. STANDARD / (#)	AS PER MFG. STANDARD / (#).	INSPC. REPORT	✓	P	W	-	(#) REFER NOTE-8

NOTES:
1. Routine tests on 100% motors shall be done by the vendor. However, BHEL/ Customer shall witness routine tests on random samples. The sampling plan shall be mutually agreed upon.
2. For exhaust/ventilation fan motors of rating up to 1.5 KW, only routine test certificates shall be furnished for scrutiny.
3. In case test certificates for these tests on similar type, size and design of motor from independent laboratory are available, the same is valid for 5 years.
4. BHEL reserves the right to perform repeat test, if required.
5. After packing and prior to issue MDCC, photographs of items to be despatched shall be sent to BHEL for review.
6. In case of any changes in QP commented by customer at contract stage, same shall be carried out by bidder without any implication to BHEL/ Customer.
7. Project specific QP to be developed based on customer requirement.
8. For export job, BHEL technical specification for seaworthy packing to be followed.
9. Packing shall be suitable for storage at site in tropical climate conditions.
10. Latest revision/ year of issue of all the standards (IS/ ASME/ IEC etc.) indicated in QP shall be referred.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,
** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, B: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **C**: CUSTOMER,
P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR**, CR:** CRITICAL
D: DOCUMENTATION

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

SUB-SECTION IA

CUSTOMER SPECIFICATION

(GENERAL TECHNICALSPECIFICATION (GTS))

CHAPTER – 1

GENERAL REQUIREMENT

Contents

CHAPTER – 1
GENERAL REQUIREMENT

1.1 Scope

1.1.1 Chanju-III HEP is envisaged to be an underground Power House having 3x16 MW generating units. This chapter specifies the general requirements applicable to materials, working stresses and workmanship involved in the design, Engineering and manufacturing of Generating Units with Associated Auxiliaries, Generator Transformers, 145 kV GIS, XLPE Cable and other Power Plant Equipment covered by these technical provisions and drawings in the bidding documents. Supplementary requirements of special nature are specified in subsequent chapters, where necessary.

1.1.2 The detailed & specific technical requirements regarding design, Engineering, manufacture, supply, erection, testing & commissioning of Generating Units with Associated Auxiliaries, Generator Transformers, 145 kV GIS, 132 kV XLPE Cables and other Power Plant Equipment are covered separately in Chapter 2 to Chapter 22 of these specifications. The power frequency and lightning impulse insulation of the equipment given as in Chapter 2 to Chapter 21 shall be updated / corrected during detailed engineering and design, as per the installation elevations shown in the drawings.

1.1.3 The work shall be carried out complete with all fittings, accessories and components, whether specifically mentioned or not but which are necessary for satisfactory performance under the various operating conditions specified in the specification here in. All such parts shall be deemed to be included within the scope of supply. All pressurized piping attachment (i.e. air release valve, deluge valve etc.) shall be provided with safety guard valve. Mandatory spares, tools and tackles and all other accessories required during operation & maintenance are included in the scope of supply.

1.1.4 The Contractor shall be responsible for complete design engineering of the E&M equipment covered under this specification and prepare layout drawings including details of foundation block-outs etc., schematics, piping drawings, cable schedule, cable routing drawings, interconnection drawings etc. and submit the same for the approval of HPPCL. Services like illumination etc. should keep on working and any repair/replacement of same should be in contractor's scope till COD of plant.

1.1.5 The parameters & quantities of the equipment specified are indicative only. If

there is any change in the rating and quantity of the equipment during the detailed design & engineering, the equipment of that rating & quantity shall be supplied without any extra cost to HPPCL. ~~The Contractor shall prepare design memorandum containing the main parameters of all the equipment selected by him, the safety factors adopted, the material used for fabrication of components in line with the latest design practice and the safety measures adopted against earthquake, flooding and fire in the station. The Contractor will submit this memorandum for HPPCL approval~~. The equipment shall be provided with the Space Heaters for de-condensation wherever required.

1.1.6 Embedment shall be supplied prior to the dispatch of the equipment and the Contractor shall Co-ordinate with Civil Contractor for this purpose. Within one month of Commencement of Works, the Contractor shall provide the details of the loading of various equipment/components required for designing of civil structures etc.

1.1.7 The installation (onsite erection) work shall also cover all the equipments required during installation and commissioning including technical services and any other thing necessary for carrying out the work. The bidder is advised to visit the site and fully acquaint himself with the site conditions and requirements of the job.

1.1.8 The Contractor shall prepare & submit "Operation and Maintenance Manual" ~~for power plant operation~~ covering all equipment.

1.1.9 The Contractor shall prepare & submit "cable schedule" ~~of complete powerhouse, Transformer hall, and pothead yard & dam area~~ after incorporating the details of cables terminations for the approval of HPPCL. Any type of cable shall not be routed through Generator Transformers cavern from the outside / inside of P/H to bonafide equipment. Any type of cable shall not be installed / routed through walls/floor/ roof of Control Room of P/H to have effectiveness of HVAC system. RTU panels relating to GSU signals are placed outside the transformer caverns.

1.1.10 The Contractor shall prepare & submit the Completion Report of the plant which shall include Layout drawings, Control/Protection logistics comprising of Unit control schematic, Unit Annunciation scheme, Unit lock-out and non lockout

scheme, Start & Stop sequence logic, Schematic Drawing and general arrangement drawings for various auxiliary system (such as fire fighting system, ventilation system, compressed air system, lubricating oil system, cooling water supply system, dewatering system, internal communication system, EOT crane etc,), single line relaying & Metering diagram of the Main Equipment, Single line diagram of DC supply system, AC Supply System, Important manufacturer's drawings (including foundation drawings), technical details and cost of all the equipments covered under the contract, write-up on the various electrical protection relays with its setting, Control supervisory & protection system, various interlocking (electrical/mechanical), governing equipments vis-à-vis various setting, Forebay levels and Intake gate signals etc, machine characteristics, Reports of pre-commissioning/commissioning tests, cable schedule and termination details, address/telephone nos../fax nos. etc of various supplier and main/sub-contractors, specific issues related to change in specifications during erection at site, salient features of the project, physical layout of all piping arrangement, cables at different elevations, list of spares available at the time of handing over of the plant.

1.1.11 The contractor shall also prepare & submit a document containing the reports of the tests conducted during the manufacturing, erection, testing & commissioning of all the equipment covered under thecontract.

1.1.12 The work must be carried out in coordination with the suppliers of other equipments and civil construction agencies at site. The work must be carried out in a business like manner with a view to achieve overall economy and efficiency and completion of the project as per schedule.

1.1.13 At least 20% of cores shall be provided as spare cores in each control and instrumentation cables.

1.2 General Requirements for Equipments

~~1.2.1 Incorporation of CEA Guidelines~~

~~The Contractor has to make provision for the incorporation of the following CEA guidelines (wherever applicable):~~

~~i. Installation of submersible type drainage and dewatering pumps, provision of suitable number of submersible pumps of adequate~~ capacity at MIV floor with provision for automatic starting by means of ~~level switches.~~

1. Ambient air temperature(Outdoor)
   (i) Maximum 40^0C
   (ii) Minimum (-) 10^0C
2. Average temperature (Indoor) +20^0 C +30^0C
3. Relative air humidity up to 100%

The Equipment shall be suitable for operation at an elevation of approximately 1640.0 m above sea level and above for Powerhouse Complex & EL 2086.91 m for BFV House (for indoor installation) and1638.0m above sea level (for outdoor installation). All the Equipment shall be designed to withstand vibration caused by earthquake forces of the order of 0.5 g in all three directions with a frequency of 10 c/s.

1.2.3 Specification Drawings

The specification drawings are enclosed separately in Volume-V of the Bidding Documents. The specifications shall be read in conjunction with the drawings. The quantity shown on the drawings are tentative.

1.2.4 Applicable Standards

1. Standards Organizations

Except as specified in the Specifications, all materials, equipment, fabrication and testing thereof shall conform to the latest applicable standards contained in the following list or other equivalent internationally accepted standards.

IEC - International Electro-technical Commission
IEEE - Institute of Electrical and Electronic Engineers
ISO - International Organization for Standardization
ANSI - American National Standards Institute
ASME - American Society of Mechanical Engineers
ASTM - American Society for Testing and Materials
NEMA - National Electrical Manufacturers Association
BIS - Bureau of Indian Standard
JIS - Japanese Industrial Standard
JEC - Japanese Electro-technical Committee

AGMA - American Gear Manufacturers Association

AWS - American Welding Society

CMAA - Crane Manufacturers Association of America

NFPA - National Fire Protection Association

SSPC - Steel Structures Painting Council

2. Specific Standards

- Pressure Piping	ANSI/ASME B31.1
- Piping, Flanges & Fittings	ANSI/ASME B16
- Screw Threads	ANSI/ASME B1.13M
- Pipe Fasteners	ANSI B18
- Pressure Vessel Inspection	ASME Boiler and Pressure Vessel Code, Section V
- Pressure Vessel Design & Fabrication	ASME Boiler and Pressure Vessel Code, Section VIII, Division 2
- Pressure Vessel Welding Brazing Qualification	ASME Boiler and Pressure Vessel Code, Section IX
- Solvent Cleaning	SSPC-SPl
- Near White Blast Cleaning	SSPC-SP10
- Mechanical Cleaning	SSPC-SP3
- White Blast Cleaning	SSPC-SP5
- Pickling	SSPC-SP8
- Gear	AGMA
- Overhead crane	CMAA, BIS

3. All threaded parts shall conform to the Standards of the International Organization for Standardization(ISO).

4. Equipment confirming to any other authoritative standard, which ensures better or equal quality than the standard mentioned above is also acceptable. Where the equipment confirm to any other standard, the salient points of difference between the standard adopted and standard mentioned above shall be clearly brought out in the bid.

The contractor shall have to supply one set of English version of adopted standard / specifications complete in all respect for reference of purchaser without extra cost to Purchaser.

1.2.5 Technical Data

1. The bidder shall fill in the Technical Schedules and Other Schedules for all Equipment specified in Vol. IV of Bid document. The bidder should note that complete information and / or non-supply of information as per Schedules may result in treating the bid as substantially non-responsive.

2. The successful bidder (i.e. supplier) upon completion of detailed design shall review the data supplied by him in the bid and obtain approval of the data (detailed design) from the Purchaser. In this review the Supplier, however, shall not change the rating and general technical data and guaranteed values of the losses given in the bid. Further, the data regarding quantities and weights given in the bid shall not vary by more than 10% as far as possible. The final and approved data shall form the basis of the contract.

1.2.6 Units of Measurement

Units of measurements shall be in the MKS / SI system and Celsius for temperature.

1.2.7 Materials

1. General Requirements

All materials used in the manufacturer of the equipment shall be of first class commercial quality, as normally used for these type of equipment, considering strength, ductility, durability, best Engineering practice and the normal or severe operating service conditions to which the equipment will be subjected, free from any defects and imperfections, of recent manufacture and unused, and where indicated, of the classifications and grades designated therein. Materials not specifically described herein shall be the most suitable for the purpose and shall comply with the latest specifications of the American Society for Testing and Materials (ASTM) or the Bureau of Indian Standards (BIS). Material Standards or approved equivalent standards. If the supplier desires for any reason to deviate from or use materials not covered by these specifications

he shall state the exact nature of the deviation or exception and shall submit for the approval of Purchaser complete specifications of the materials he proposes to use along with the reason of such deviation. All materials, supplies, and articles not manufactured by the supplier shall be the products of recognized reputable manufacturers.

2. Corrosion Resisting Materials

a. Bronze hinge pins shall be provided for allman-doors.

b. Corrosion resisting materials shall be used in the main units, accessories and appurtenances as follows :

i. Bolts or nuts, when either is subject to frequent removal.
ii. Bolts projecting from concrete, with nuts subject toremoval

c. All sliding surfaces that operate in water shall have non-ferrous liners if not otherwise specified.

d. All sliding surfaces subject to continuous contact with grease over extended periods without movement shall be bronze or bronze faced.

e. Substitutions for specified materials shall be made only with the written consent of Purchaser. The Supplier shall be responsible for the suitability of materials to be used in the construction of the equipment covered in various Sections of thesespecifications.

f. To the extent feasible and without adversely affecting the strength and durability, materials for field welds if required shall be used that do not require preheating or stress-relieving.

1.2.8 Material Tests

1. All materials, parts and assemblies thereof entering into the work to be done under these specifications shall be tested, unless otherwise directed, according to the applicable ASTM/BIS Standard or the best modern approved commercial method for the particular type and class of work. The supplier shall prepare specimens and perform tests and do analysis to demonstrate conformance of various materials with the applicable specifications given herein. In case the Supplier desires to use stock materials not manufactured specifically for the equipment covered by these specifications, he shall submit satisfactory evidence to Purchaser that such material conforms to the requirements herein stated, in which case tests on these materials may be waived. Certified mill test reports of

plates will be acceptable. Routine test reports for minor components will be acceptable.

2. All materials shall comply with the requirements of design and type tests shall be subjected to the routine tests prescribed for such equipment. Besides routine tests, the contractor may perform any other tests, which may be considered necessary keeping in view the development in technology. Five (5) nos. of certified copies of all these test certificates duly attested by the inspecting authorities should be supplied in one lot to the Purchaser before the dispatch of theequipment.

3. To facilitate the presence of the Purchaser's representatives during testing, the contractor will notify the approximate testing dates, 15 (Fifteen) days in advance. Purchaser will nominate his representatives and inform the contractor with in this time the program of his representatives, so that the testing schedule is not disturbed. Inspection, examination or tests performed at factory shall not relieve the contractor from any obligation under the contract. No portion of the work shall be considered completed in accordance with the terms of the contract until the inspector shall have certified in writing that it has been inspected and approved by him. The expenses involved in travel/boarding & lodging etc. in sending the inspectors to carry out the inspection and / or tests at the place agreed upon in the contract will be defrayed by the contractor and shall be included in the prices stated in the schedule of prices. In the event of inspection and / or tests proving unsatisfactory and resulting in non-acceptance of plant/equipment or any portion thereof the cost of such inspections and / or tests (including the travelling, boarding and lodging etc. expenses) shall also be borne by the contractor.

4. Acceptance of materials, parts, and assemblies, or the waiving of the inspection thereof by Purchaser, shall in no way relieve the supplier of the responsibility for furnishing equipment meeting the requirements of these specifications.

1.2.9 Equipment Labelling

1. Approved Labels

Approved labels, for example the ASME's label to the pressure vessel, shall be attached to equipment where required by the regulating authority having

jurisdiction or by the specified governing standard.

2. Nameplates

All Equipment shall be suitably identified with nameplates. Nameplate lists shall be submitted for approval.

a.Nameplates for indicating the name of panel, board, junction box, etc., shall be laminated plastic, screw fastened and use the English language with black lettering on a white field. Minimum letter size to be 4mm. Nameplates shall be in a prominent, readily accessiblelocation.

b.A permanent corrosion resistant metal nameplate showing the following information shall be permanently mounted on each major piece of equipment:

i. Equipment designation
ii. Manufacturer's name and address
iii. Serial number
iv. Part number
v. Date of manufacture
vi. Equipment ratings

3. Warning Notices

Warning labels shall be provided on or in all electrical equipment where terminals at dangerous voltages (including 415/230V) may be exposed during maintenance. Warning labels shall be of plastic laminate with white lettering on a red background.

1.2.10 Design Stresses

1. General Criteria

Liberal factors of safety shall be used throughout the design, and especially in the design of all parts subject to alternating stresses or to shock loading or to most severe operational loadings, including those due to electrical short circuit faults. The supplier shall furnish for record of Purchaser complete information

including computations, regarding the maximum unit stresses used in the design.

2. Allowable Unit Stresses

a. As such contractor shall be responsible for an adequate design based on factors proven safe in practice and shall use lower working stresses. Generous factor of safety shall be used throughout the design, especially in the design of parts subject to alternating stresses, vibration, impact or shock. Under the most severe operating conditions, the unit stresses in the materials shall not exceed the values shown in **Table1-1**:-

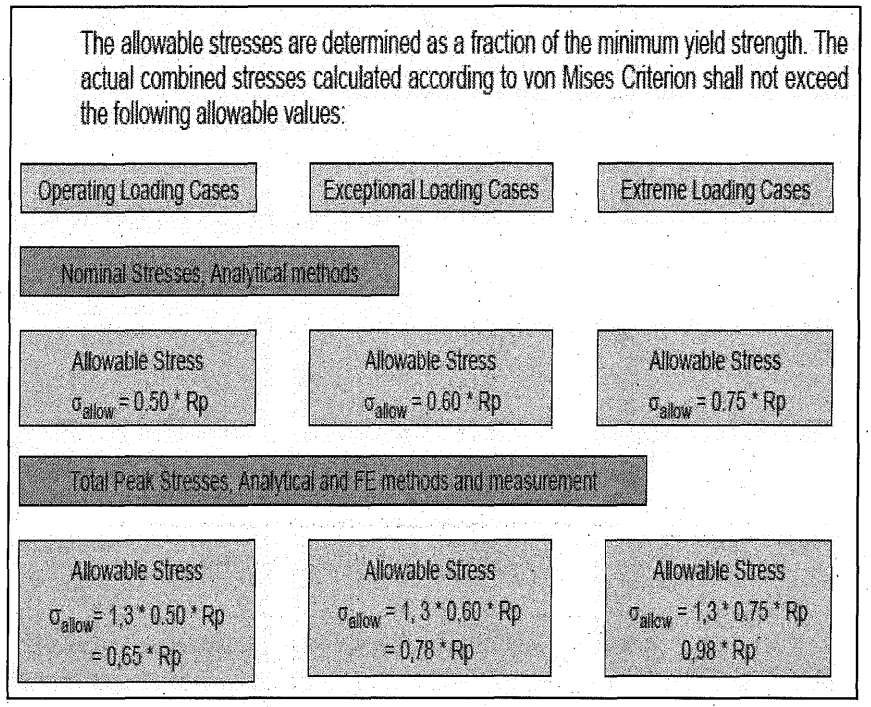
TABLE - 1.1

Material	Maximum Unit Stress	
	In Tension	In Compression
Gray Cast Iron	One-tenth (1/10) of the ultimate tensile strength	700 kg/cm^2
Steel Forgings, Cast Steel and Alloy Cast Steel	One fifth (1/5) of the ultimate tensile strength or one-third (1/3) of the yield strength, whichever is lower	One-fifth (1/5) of the ultimate tensile strength or one-third (1/3) of the yield strength, whichever is lower
Plate Steel for Principal parts subject to hydraulic stresses.	One-fourth (1/4) of the ultimate tensile strength but limited to 1050 kg/cm^2	One-fourth (1/4) of the ultimate tensile strength but limited to 1050 kg/cm^2

b. For other materials, not covered in **Table 1.1**, used in the construction of the E&M equipment specified in this bid document, the maximum stresses in tension or compression due to the most severe conditions occurring in normal operation shall neither exceed one-third of the yield strength nor one- fifth of the ultimate strength of the material. Maximum stresses in shear shall not exceed 210 kg/cm^2 in components made from cast iron and shall not exceed 60 percent of the allowable stresses in tension for other materials.

c. Under hydrostatic test conditions, max. unit stresses in any parts of the equipment shall not exceed 2/3 rd of the Yield Strength.

d. In addition to above, the relevant stresses as shown below shall also be acceptable:



1.2.11 General Requirements of the Equipments

1. All the Equipment shall be new and durable to withstand long time service, and shall satisfy all requirements of the Specifications. Any item or device not specifically called for in the Specifications but which is necessary to provide a complete and successful working system shall be furnished by the Contractor.
2. All the Equipment shall be of a convenient construction for disassembling, inspection and erection. Insofar as practical, devices and equipment used for the same or similar service shall be of the same make and type and shall be interchangeable for the same rating.
3. Wherever possible, all similar parts, including spare parts, shall be made interchangeable. Such parts shall be of the same materials and workmanship and shall be constructed to such tolerances as to enable substitution or replacement by spare parts easily and quickly.
4. Miscellaneous Metalwork and Handling Provisions

   The Contractor shall provide and install in respect of the Equipment to be supplied, the following miscellaneous metalwork unless otherwise specified:
   a. soleplates, bedplates, foundation bolts and anchorbolts;
   b. platforms, ladders, guards, and handrails necessary for easy and safe access to the Equipment;
   c. safety guards at each point where normal access would permit personnel to come within reach of any moving item of plant;
   d. lifting lugs, eyebolts or other lifting attachment;
   e. wall hooks and manual winches shall be supplied for equipment out of crane range.

5. Threaded Fasteners

Bolts, nuts, studs, screws and washers shall be to the ISO metric system unless otherwise approved. The extent to which other Standards are proposed shall be indicated in the Tender. Threaded fasteners shall comply with the following requirements:

a.Steel fasteners shall be forged unless otherwise approved;

b. Steel fasteners shall be zinc plated unless otherwise approved;

c. all parts shall be spot-faced or machined for nuts or bolts except in the case of clearance bolts in structural steelworks;

d. Tapped holes shall not be used in sheet metal less than 5mm thick;

e. fasteners of less than 6mm diameter shall not be used except in instruments and small electrical and mechanical devices;

f. threaded fasteners of more than 8mm diameter shall have hexagon or socket hexagon heads;

g. all threaded fasteners shall be locked in an approved manner;

h.lock washers shall not be used with high strength bolts and nuts, only hardened flat washers will be permitted;

i. bolts and nuts shall be checked for tightness prior to commissioning.

1.2.12 Electric Welding

1. General Requirements

All welding shall be performed by the electric-arc method.

2. Preparation forWelding

Members to be joined by welding shall be cut accurately to size, with edges sheared, flame-cut, or machined to suit the required type of welding and to allow thorough penetration and good fusion of the weld with the base metal.

The cut surfaces shall be free of all visible defects such as laminations, surface defects caused by shearing or flame cutting operations, or any other injurious defects. The surfaces of plates to be welded shall be free from rust, grease, and other foreign matter along the edges prepared for welding.

3. Welding Codes

All welding for the fabrication of principal stress-carrying parts shall be in accordance with the latest version of BIS: 2825 or to Part UW of Section VIII of the American Society of Mechanical Engineers (ASME) "Boiler and Pressure Vessel Code", with the exceptions regarding stress-relieving stated below. All welding for the fabrication of other parts shall be in accordance with the applicable requirements of paragraphs 401 through 403 and 406 through 410 of the "Standard Code for Arc and Gas Welding in Building Construction" of the American Welding Society (AWS) or other equivalent approved standard.

4. Stress-relieving of Parts

All weld-fabricated parts except minor parts, those where stress is not important, or those which are specifically exempted from stress-relieving shall be stress-relieved as a unit prior to final machining. The supplier shall furnish all special materials, equipments, or techniques required for pre-heating or post-heating of members to be joined by field welding. Localized stress-relieving will not be permitted for shop-welded parts of principal stress carrying components.

5. Welding Qualifications

For welding of principal stress-carrying parts, the qualification of welding procedures, welders, and welding operators assigned to work covered by these specifications shall conform to the relevant BIS or the requirements of Section IX of the ASME "Boiler and Pressure Vessel Code". For welding of other parts, the qualifications of welding procedures, welders, and welding operators shall conform either to Section IX of the ASME "Boiler and Pressure Vessel Code", or AWS "Standard Qualification Procedure" or to relevant BIS. If at anytime, the work of any welder or welding operator appears questionable, such operator will be required to pass additional qualification tests to determine his ability to perform the type of work on which he is engaged. All such additional

qualification tests for welding operators and the physical test of the welded specimens shall be made in the presence of Engineers. All expenses in connection with making such qualification tests for welders and welding operators shall be borne by the supplier.

6. Quality of Welds

The design of welded joints and the welding procedures for both field welds and shop welds, in addition to conforming to the requirements set forth in the applicable code and/or in these specifications, shall meet the following requirements for workmanship and visual quality:

i) Butt welds shall be slightly convex, of uniform height, and shall have full penetration.

ii) Fillet welds shall be of specified size, with full throat and with legs of equal length.

iii) Repair, chipping, or grinding of welds shall be done in such a manner as not to gouge, groove, or reduce the base metal thickness.

7. Radiographic Inspection

Radiographic and ultrasonic examination of welds will be required, as specifically stated in these specifications, and when, in the opinion of Purchaser, doubt exists as to the quality of certain welds. Any such radiographic and ultrasonic inspection shall be without any cost to Purchaser. All welded joints of components subjected to penstock hydrostatic pressure and welds of other important stress-carrying parts shall be 100% radio graphically inspected where practical, and shall conform to quality requirements of IS:2825 or of the ASME Code for radiograph quality welds. Where radiographic inspection is not practical, other non-destructive testing such as ultrasonic, dye-penetrant, magnetic particle, or a combination of tests, shall be used. The results shall be submitted to Purchaser.

1.2.13 Steel Castings

1. General Requirements

Castings shall be free from injurious defects and shall be free of foundry irregularities such as projections, ridges, hollows, honey-combing, pock marks, or chip marks, so that they will not require surface smoothing operations in the field prior to painting. The location of existing defects shall be determined, and they shall be completely removed to sound metal. The structure of the castings shall be homogenous and free from excessive non-metallic inclusions. An excessive segregation of impurities or alloys at critical points in a casting will be cause for its rejection. All castings involving welded fabrication shall be stress-relieved.

2. Inspection and Repair

a. The supplier shall notify Purchaser in ample time to have an inspector present at the foundry, if Purchaser so desires, when the castings are cleaned and defects if any, chipped to sound metal, before any repair welding is done. After the repairs of castings, same shall be heat-treated.

b. Test pieces for tension and bend test specimens shall be removed from the castings at the time of inspection. Certified copies of the test reports shall be furnished as specified. The supplier shall make non-destructive tests for important load carrying castings as appropriate prior to final machining. Radiographic or magnetic particle inspection, ultrasonic or other non-destructive tests may be required by Purchaser when it is desired to make such tests as a means of judging acceptability of castings which contain defects of apparent borderline seriousness or to determine that repair welds have been properly made. Any such tests shall be without any extra cost to the Purchaser.

3. Repair Welding

a. The repairs of major defects casting shall not be carried out without prior approval from Purchaser. Defects shall be considered major when the depth of the cavity properly prepared for welding exceeds 20 percent of the wall thickness or 25 millimeters, whichever is smaller.

b. The welding of defects shall be performed only by welders or welding operators qualified in accordance with sub paragraph 1.2.11(5) and shall conform to the best modern welding practice.

c. If the removal of metal to uncover a crack or remove a defect reduces the stress- resisting cross-section of the casting to such an extent that the computed unit stress in the remaining metal is less than 30 percent in excess of the allowable stress, the casting may, at the option of Purchaser, be rejected.

d. The repairs carried on casting repairs by welding of major defects at any stage of manufacture after the first heat treatment (annealing) shall be stress-relieved. The minor defects or imperfection that will not ultimately impair the strength or service ability of the castings may be repaired by welding in accordance with accepted commercial casting practice without securing approval. However, an accumulation of minor defects which in the opinion of Purchaser casts serious doubt as to the general quality of the casting may constitute cause for rejection.

4. Dimensions

Thicknesses and other dimensions of the castings shall conform substantially to the dimensions on the drawings and shall not be reduced by shop or foundry practices to the extent that the resulting stresses in the metal will exceed the stresses allowed under these specifications. Castings shall not be warped or otherwise distorted, nor shall their dimensions be oversize to such an extent as to interfere with proper fit with other parts.

5. Surface Finish

a. Surface finish shall be indicated on the detail drawings and shall conform to the requirements of ANSI B46.1 "Surface Roughness, Waviness and Lay", or other approved equalstandard.

b. All parts shall be free from burrs, sharp edge and imperfections in cutting, machining and welding. All visible parts shall receive special attention in order to ensure pleasing appearance of the completed machine.

~~1.2.14 Piping and Valves~~

~~1. All necessary Piping, tubing and pipeline materials and equipment for water, oil, air and the control system for the work of this contract shall be of~~

~~Manager. All tests of piping shall be witnessed by the Project Manager.~~

1.2.15 Painting and Protective Coating

1. General

a. Equipment, piping, valves and other items that require painting shall be painted in the Contractor's shop if practical.

b. Painting shall include preparation of the surfaces to be painted, paint application, protection and drying of the paintcoating.

c. The Contractor shall submit a complete painting procedure covering allocating systems to be used and including:

- Paint Materials (include product datasheets)
- Equipment
- Environmental Controls
- Surface Preparation
- Material Application and Methods
- Curing
- Testing and Inspection
- Documentation

d. Unless otherwise specified, the manufacturer's standard painting system will be acceptable for miscellaneous small auxiliary equipment such as fractional horsepower motors, contactors, gauges, pressure switches, etc. provided the surface to be painted is properly cleaned, primers are applied to a minimum of 25microns dry film thickness and finish coats to at least 25microns dry film thickness.

e. Paint finished shall have a neat appearance and shall be free of runs, sags, pinholes, drips, ridges, waves, laps, brush marks, or other film defects.

f. The coating shall exhibit full adhesion to the substrata andundercoats.

g. Paint shall be applied so as to produce an even film to the specified dry thickness. Edges, corners, crevices, welds, bolts and rivets shall receive special attention to ensure their receiving a coating of the required

thickness.

h. The underside of steel equipment and cabinet bases which will be inaccessible except by disassembly or moving the equipment shall be protected by a 1.5mm bituminoussealcoat.

i. The temperature of the substrate shall be at least 3°C above the dew point during surface preparation, coating application, curing anddrying.

j. The final painting coat on piping, vales and supporting brackets shall be done after installation to ensure neat and aesthetic appearance.

2. Shipping Handling and Storage

a. Coating materials shall be delivered to the place of application in the manufacturer's unopened, original containers bearing a legible product designation, batch number and date of manufacture. Containers which are damaged to the point of exposing the contents shall not be used.

b. The material shall be handled and stored in accordance with the manufacturer's latest published instructions and shall be protected from damage, moisture, direct sunlight, and temperature below 10°C and above 35°C.

c. Containers of coatings or components shall not be opened except for immediate use.

d. Materials shall be used within 12months of their manufacture, and in no case shall exceed the manufacturer's recommended shelf life.

e. Coated surfaces shall be protected from damage during lifting and handling. Non-abrasive supports shall be used for shipment and storage.

3. Surface to be Painted

All surfaces shall be shop painted except as noted in the following clause.

4. Surfaces Not to be Painted

The following surfaces shall not be painted:

a. Contact surfaces of bolted joints shall be primed but not painted

b. Mating, rolling or sliding machined and non-ferroussurfaces

c. Components where the function may be obscured or hampered such as gauges, sight glasses, nameplates, proximity switch actuators, etc.

d. Components such as electrical cables, belts, hoses, seals, etc.

e. Surfaces to be embedded in concrete

f. Shafts

g. Surfaces with the width of about 300 mm straddling the field-weld zone

h. PVC and metal insulation covering for piping

5. Surface Preparation

Oil and grease shall be removed from surfaces to be painted in accordance with SSPC Specification SP-1, "Solvent Cleaning". Following solvent cleaning, all welds in water passage surfaces shall be ground smooth, all weld spatter, slag, burrs or other rough protrusions shall be removed by grinding or chipping, and all surfaces to be painted, except machined surfaces, shall then be thoroughly cleaned in accordance with the requirements of the coating manufacturer. Surfaces to be painted which are sandblast or shot blast cleaned in accordance with SSPC SP-5 and SSPC SP-10 shall be primed within 24hours after sandblasting. Other surfaces to be painted shall be primed within 24 hours after sandblasting and in any event, all surfaces shall be primed before any visible rusting or contamination occurs. If any rusting or contamination occurs, the affected area shall be re-cleaned to the same degree as described above. Surface profile shall be between 25 and 75 µm or in accordance with paint manufacturers' recommendations.

a. Paint material and application

Paint shall be applied in accordance with the paint manufacturer's published instructions.

b. Stainless steel surfaces

Machined stainless steel surfaces shall be cleaned, and then shall be protected with the Contractor's recommendable methods for keeping away the surfaces from minor mechanical damage and corrosion during shipment and storage at the Site.

c. Treatment of surfaces notpainted

i. Unless otherwise noted, all unpainted surfaces, except for surfaces in contact with concrete, shall be protected against corrosion during shipment, storage and installation, with a rust preventative compound or other suitable means that is readily removable duringinstallation.

ii. Surfaces not to be painted shall be protected by appropriate and adequate masking during the cleaning and painting of adjacent metalwork. Scratches, scuff marks, welding beads and other unsightly scars unfinished metal surfaces, aluminium or other non-ferrous metal shall be removed so as to form a neatfinish.

6. Field Painting and Touch-Up

a. A final finish coating for all Equipment, except for the boards and panels which have been shipped after the baked painting, shall be done by the Contractor at the Site.

The Contractor shall furnish the necessary quantity for the paint. In addition to the final coat's paint, the Contractor shall furnish sufficient quantity of all kinds of paints for the touch-upuse.

b. Any damage to primer and finish coatings sustained during shipments installation or testing of the Equipment installed under this Contract shall be restored by touch-up at theSite.

c. All paints shall be shipped to the Site in resalable containers for this purpose.

d. Each day's work shall be subject to inspection by the Project Manager. All surface preparations shall be subject to approval by the Project

Manager before any application of coating materials can be made. At any stage of application, visual or physical inspection may be made at the direction of the Project Manager.

Inspection of the completed work will be made by use of the magnetic type film thickness detectors and holiday detectors. Visual inspection for pinholes, sagging or any other coating defects will also be made. If more than 5 coating defects are found in $10m^2$, the Project Manager may require removing or re-coating the entire defectivearea.

At the discretion of the Project Manager, occasional small spot tests may be made with a sharp instrument to physically gauge film thickness or determine other qualities of the coating.

7. Color Schedule

Finish paint and coating colors shall be directed by the Project Manager after award of the Contract.

8. Coating Schedule

Paint coatings shall be in accordance with the following schedule. The Contractor's proposed coating products and procedures for each of the listed categories to be used shall be submitted for approval.
Coatings and paints shall be lead free.

a. Ferrous metal surfaces - interior, dry

- One coat red oxide steel primer, 50µm
- One coat tinted enamel undercoat, 38µm
- One coat exterior gloss enamel, 25µm

b. Ferrous metal surfaces - exterior, wet or submerged

- Surface preparation to SSPC S-10 Near WhiteBlast
- One coat epoxy primer
- Two coats high build epoxy enamel (2 part),250µm

total dry film thickness. (non-toxic & suitable for potable water)

c. Galvanized and zinc coated metal

- One coat vinyl wash primer for galvanizedsurfaces
- One coat tinted steel primer, 38 µm, interior
- One coat exterior gloss enamel, 25 µm, exterior
- Two coats exterior gloss enamel, 25µm/coat

~~d. Piping - steel and copper~~

- ~~One coat red oxide primer, 50µm~~
- ~~One coat enamel undercoat, 38µm~~
- ~~Two coats exterior gloss enamel, 25µm/coat~~

~~e. Piping stainless steel~~

- ~~One coat tinted enamel undercoat, 25µm~~
- ~~One coat exterior gloss enamel, 25µm~~

~~f. Piping, plastic~~

- ~~One coat alkaloid resistant primer, 50µm~~
- ~~Two coats exterior gloss enamel, 25µm/coat~~

~~g. Fabric, wood and porous~~ ~~materials~~

- ~~One coat sealer primer~~
- ~~One coat tinted enamel undercoat, 25µm~~
- ~~One coat gloss exterior enamel, 25µm~~

h. Other

Coating systems for materials not listed above shall be subject to approval by the Project Manager.

9. Galvanizing

a. The steel structure exposed in outdoor shall be completely hot-dip galvanized, except for part which shall be embedded in concrete foundation. All ferrous materials shall be hot-dip galvanized to meet the requirements of ASTMA123.

b. All component members shall be galvanized after all necessary cutting, drilling and other work are completed. The galvanizing shall be applied by the hot-dip process.

c. Zinc coating with Hot-Dip for bolts, nuts, washers, locknuts, step bolts, ladders and similar hardware shall meet the requirements of ASTM A153. Excess zinc on bolts, nuts, washers, locknuts, step bolts, ladders and similar hardware shall be removed by appropriate means acceptable to the Project Manager. The threads of bolts shall not be retapped after coating.

d. Cleaning

After fabricating has been completed, all materials shall be cleaned of rust, dirt, oil grease and other foreign substances.

e. Coating weight of galvanizing

The hot-dip zinc coating shall be uniform clean and of a standard thickness on the entire surface of all materials.

The hot-dip galvanizing coating shall meet the values as shown in the following table.

Galvanizing Coating Weight

Description	Thickness	Coating Weight (g/m^2)		Uniformity Time 1min/1time
		Average Value	Minimum Value	
Shaped Steel	over 6 mm	more than 700	More than 610	more than 5
Steel Plates	under 6 mm	more than 610	More than 550	more than 5
Bolts, Nuts, Washer, etc.	—	more than 470	More than 400	more than 4

Galvanizing routine tests for uniformity of all galvanized materials shall be performed by the Contractor in accordance with the applicable designations given in the ASTM.

f. Repair of galvanizedmember

Materials on which galvanizing has been damaged or ungalvanized at the factory shall be redipped or regalvanized. Damage due to local transportation or erection may be repaired by applying a coating of galvanizing repair paint such as zinc rich paint "Roval" or equivalent if approved by the Project Manager. Where, such repair is authorized, the damaged area shall be cleaned with wire brush and wiped with clean rag saturated solvent to remove residues before a heavy brush coat of galvanizing repair paint is applied.

1.2.16 Lubrication

1. Components requiring lubrication shall have effective lubricating provisions.

2. Greasing or lubricating points shall be grouped in accessible locations. Pressure, gauges and level indicators shall be installed in prominent locations. Dipsticks, leakage drip plates, lubricant sight glasses, drain plugs and filtered air vents shall be provided for all oil sumps and reservoirs. Dipsticks and covers of lubricating pipes of bearing or shafts shall be fitted with a chain to prevent their loss. Lubrication equipment shall be tested at 1.5times the maximum operating pressure.

3. The Contractor shall submit a lubrication schedule for the Equipment, showing the recommended frequency of application and types and grades or required lubricants. The recommended lubricants shall be approved by the Project Manager.

4. The lubricant available in India and satisfying the international standard is preferable to the Purchaser.

1.2.17 Instruments

Instruments shall be capable of withstanding, or shall be adequately protected from the vibrations, shocks, water drops, sunbeam, electric noises, etc. which may be encountered in service. Protection class of instruments case shall be generally of the NEMA type 4 (water-tight and dust-tight).

Instruments and associated apparatus shall be capable of maintaining their accuracy and sensitivity during long time without excessive maintenance.

1. Indicating Instruments

a. Analogue type instruments

i. These instruments shall operate on electrical input signals from various measuring devices. The instruments shall be moving coil, flush-mounted, dust tight type with 1.5% accuracy, unless otherwise specified, within a temperature range from -25□C to 45□C and under a nominal range specified in IEC 51. Instrument cases shall be positively grounded.

ii. Instruments on the outside of enclosures shall be square case, flush mounted, have non-reflective glass and be provided with narrow bezels. The bezels shall have a uniform high-grade finish. Unless otherwise approved by the Project Manager, instruments shall be more than 100mm in the side length as appropriate to theapplication.

iii. All analogue instrument scales shall be indicated in accordance with IEC51 and/or ANSI C39.1 Part1, printed in black figures and divisions on a white background. The unit measured shall be clearly marked on the instrument dial in black capital letters in an abbreviated form (eg. A for Amperes Printing which

may interfere with the clear observation of the reading shall not appear on the dials. Scales shall be provided with red-colored marks at points corresponding to the normal working values (or full-load current of the equipment in the case of ammeters).

iv. Unless otherwise specified or approved, all analogue instruments shall have circular scales with a total pointer deflection of not less than 240 degrees. Normal working indication shall be at a point corresponding to 50 to 75% of full-scale deflection.

v. The scales for ammeters in motor circuits shall be compressed so that 20% of full-scale deflection (F.S.D.) occurs at about 40% full-load current (F.L.C.) and 90% of F.S.D. at about 120% F.L.C. The scale shall be approximately linear in the range 40% to 120% and compressed above 90% F.S.D. to indicate six times F.L.C. at 100% F.S.D.

vi. Instruments with scales shall have black bar-type pointers, except in case of instruments having more than one pointer, then only one of the pointers shall be black and the other red.

vii. Suspension for electrical instruments shall be of the taut band type. Instruments shall be adequately damped to ensure that pointers come to rest rapidly after being deflected from their previous positions. End stop devices shall be provided to prevent damage to movements, pointers and suspensions under transient conditions.

viii. Device for routine checking, zero adjustment and re-calibration shall be easily accessible from the front of the enclosures. Where such devices are not included in the instrument case they shall be flush-mounted on the enclosures adjacent to the associated instruments, so that adjustments can be made conveniently while watching the indicator.

ix. Instruments provided with initiating contacts shall be arranged so that operation of the contacts neither impedes nor restricts the movement of the indicating pointers over the full range of the instruments. The initiating contacts shall be adjustable.

x. Dual or multiple range instruments shall be provided with a range selector which shall be readily accessible to the operator without opening the front cover of the instrument.

xi. The power supply for the transducers and recorders shall comply the specification of1.2.17.

b. Digital type instruments

The indicating element for each digital indicator shall be of seven-segment LED illumination type (Green).

The number of digits of each digital indicator shall be selected to suit the required indication, and shall preferably be as follows:

- Voltage indications	3 digits (999 kV, 99.9 kV or 999 V)
- Ammeter	3 digits (9.99 kA, 999 A or 99.9 A)
- Frequency indicators	3 digits (99.9 Hz)
- Speed meter	3 digits (999 rpm)
- Watt indicators	3 digits (999 MW)
- Var indications	3 digits (999 MVar)
- Water level indicators	5 digits (999.99 m)
- Gate opening indicators	3 digits (999 mm, 999% or 99.9%)

The watt and var indicators for the circuits where the direction of power flow may be changed, shall be provided with "+" and "-" signs.

2. Gauges

a. Oil level gauges

Oil level gauges to be used for bearing oil tanks of Turbine and Generator shall be of dial type with a float and shall fitted with appropriate protective cover against damages. It shall be constructed so that there is no oil leakage.

The gauges shall be fixed at locations convenient for checking oil level even during operation. Normal upper and lower limits of oil levels shall be inscribed on the gauges.

b. Dial type thermometers

i. Thermometers shall be of a round, liquid filled dial type with a dial (with a manually reset maximum temperature pointer), contained in a dust-proof and moisture-proof case. Their accuracy shall be within ±1%. The scale display shall be from 0□C to 100□C. The diameter of thermometer dial shall be approximately 150mm.

ii. The flexible capillary from the bulb to the dial shall be one piece, stainless steel tube, compensated typed, protected against shocks, and shall be installed in such a way as to allow removal without interfering with other parts of the installation. The capillary shall be supplied with extra length.

iii. Thermometers shall be calibrated in degree Celsius, and equipped with normally open two (2) contacts for alarm uses and hand reset maximum indication pointers. The contacts shall be easily adjustable to set the alarming/tripping temperatures, and they shall have sufficient resistance against sparks and operating current. In addition, an independent contact shall be provided to alarm when vapor pressure is lost.

iv. The thermometers shall be unaffected by variations in temperature of the capillaries.

~~c. Pressure gauges~~

~~i. Pressure gauges shall be of the bellow type or Bourdon type having aluminum or brass cases with screwed pipe connections and stainless steel movements, and shall be equipped with isolating and vent valves and effective pressure snubbers. Their accuracy shall not be less than ±1%. Pressure gauges shall be equipped with micrometer zero adjuster.~~

ii. Pressure gauges may include electrical contacts for control/alarm use. The electrical contacts wherever required shall be rated at 240V- 5A AC or 220V- 0.5A DC and mechanical span adjuster shall be internally provided.

iii. Gauges for oil and air shall be calibrated in MPa. Gauges for water shall be calibrated in meters of water. The maximum index on the pressure gauge scale shall be a pressure that is at least 1.5 and not more than 2.0 times the highest operating pressure.

iv. Gauges shall be calibrated to read the gauge pressure at the tapping point. The scales shall be marked with any compensation for difference in level between tapping point and gauge. Where pressures at the pressure gauge can fall below atmospheric, a sealed pressure transmitting system shall be used. All gauges shall be marked with a red painted line at the working pressure.

v. Where the item in which pressure is to be indicated is subject to vibration, the pressure gauge shall be mounted either on anti-vibration mountings or elsewhere with connection by flexible tubing.

d. Tank level gauges;

i. Tank level gauges shall be direct reading, glass column type or dial type with a float, and provided with the protective housing for the glass part. Connections shall be 6mm copper pipe with isolating valves. Check valves shall be installed on level gauges for pressurized reservoirs to prevent leakage if the glass breaks.

ii. The standard level and the high and low level limits shall be marked on the gauge.

e Forebay level:

One set of each type of High resolution pressure transducer and Radar type level sensor alongwith probe and other required accessories such as cable, clamping etc shall be provided and further interface with SCADA system and Level Display Meter in Intake Control Room, Butter Fly valve Chamber Machine hall.

3. Mechanical Switching Devices and Detectors

The contacts shall be solid silver or special alloy.

a. Temperature relays

i. Temperature relays shall be of vapor pressure type or liquid filled type with an operation indicator to identify easily when the relay operates and shall have two sets of normally open contacts continuously and independently adjustable within a range of not less than 40% of the maximum rated temperature of the switch. One set shall be used for alarm and the other for control circuits.

ii. The relay shall accurately operate at the pre-setting value, and shall be reset manually. It shall be so designed that resetting cannot be effective until temperature has gone down.

b. Pressure switches

Pressure switches shall be of the bellows type or Bourdon tube type, and internal mechanical adjusters shall be provided to enable continuous and independent setting. The pressure range shall be adequately selected for meeting the operation pressure variation. Two contacts (1a + 1b) shall be at least provided for alarm/control circuits. The rating of contact shall be 240 V AC 5A or 220V DC 0.5A.

c. Oil level relays

i. Oil level relays shall be of float type, accurate and reliable in operation. The oil level relays shall be installed in positions convenient to enable easy inspection and checking of operation, and shall provide suitable air release valves.

ii. A relay to be used for Turbine and Generator bearing's oil tanks shall provide two sets of electrically independent normally open contacts for the upper oil level and two sets of electrically independent contacts for the lower oil level, and shall be automatically reset as soon as the oil level returns to the designed value. One set of contacts for each oil level shall be used for interlocking the automatic starting controls and one set of contacts shall be used for alarm. Those contacts shall be operated by the magnet incorporated in the float.

iii. A relay to be used for the conservator of the transformer shall be designed

so that the float position inside of the conservator shall be transmitted magnetically through the tank wall to the indicator to preserve the tank sealing and supplied with proximity switches for high and low level alarm. The indicator shall be readable from the ground.

d. Water flow relays

i. The water flow relay shall be basically electro-magnetic type and shall be of simple construction, accurate and reliable in operation. It shall be provided with two electrically independent normally open contacts, which can be adjustable to operate at any flow rate. One contact shall be used in the automatic operating controls and one contact shall be used for alarm.

ii. The relay shall also be complete with flow indicator and all required valves, tubing, orifice plates and loose flange to facilitate adjustment and maintenance thereof.

iii. For the minor use such as water supply to air compressor, other alternative type water flow relay will be permitted after the approval of Project Manager.

e. Proximity switches

i. Proximity switches for auxiliary circuits shall be suitable for outdoor installation and have at least one make and one break contact. All proximity switches shall operate at 220V DC, unless otherwisespecified.

ii. Proximity switches shall be able to withstand at least 1,200 switching cycles per hour, under rated current conditions. Breaking capacity shall be not less than 0.55A, and making capacity 0.55A. Rated current carrying capacity shall be 0.5A and more. If the proximity switch is used for operating the solenoid or other relays directly, those current capacities shall be selected to meet the uses with enough margins.

f. Auxiliary switches

i. All high-voltage and low-voltage switchgear and control gear shall be provided with the necessary auxiliary switches for the closing and opening mechanisms and for control, indications, interlocking and other functions and shall include one make and one break contact as spare.

ii. Auxiliary switches shall be mounted on the equipment and directly coupled to the operating mechanism. The switches shall be robust and arranged so that they will not be damaged by over-travel of the drive. Contacts shall be inherently self-cleaning to ensure low contact resistance at all times.

iii. The electrical rating of auxiliary switches shall be adequate for the service conditions.

g. ~~Resistance temperature detectors(RTD)~~

~~Resistance Temperature Detectors (RTD) shall be used and shall be standard type platinum, 100Ω at 0 degreeC. The wire of resistance shall be wound on ceramic base. The RTD protecting tube shall be of the pipe thread screw-in type. Three - wire circuiting shall be utilized for connecting RTDs to the measuring units.~~

h. Vibration measurement

The vibration probe shall be of Piezoelectric acceleration sensor or proximity type based on either eddy current or, magnetic pick up. For reliability it is always desired that two probes at right angles to each other shall be utilized.

The proximity vibration sensor shall be used for measuring the rotating parts vibration/run-out. The sensor probe shall be electrically isolated where it is supported. The signal from the probe shall be adequately amplified at the vibration detector unit for providing 4-20mA/1-5V outputs.

4. ~~Transducer~~

a. ~~Transducers shall be solid-state type with an output signal range of 4 to 20mA DC or 1 to 5V DC, unless otherwise specified.~~

b. ~~The rms ripple current shall be less than one (1) percent within the rated measuring ranges.~~

c. ~~Each transducer shall be able to operate into a load impedance rangingbetween 0 and 500Ω without adjustment of the output. Transducers shall have a minimum adjustment of output current of±5%.~~

d. The transducers and their power supplies shall be designed so that no appreciable deviation in the output current is produced by switching or other voltage transients in the supply. The output leads from the transducers to the main terminal block shall be shielded.

e. The change in error in the output current shall not exceed the following values at full rated output.

AC voltage, AC current, AC active power and AC reactive power output terminals, power source terminals and grounded case	±0.5 %
V-I phase angle and power factor	±3□
Frequency	±0.1 Hz
DC transducer	±0.5 %
Temperature and other sensor use	±0.5 %

All connecting elements, cables and other accessories necessary for complete system shall be provided.

5. Recorders

a. The recorders shall be of the strip chart type with dust-proof housings. Recorders with circular charts will not be accepted.

b. The recorders, including event recorders, shall be driven by synchronous motors or DC motors, assuitable.

c. Recorders shall transport charts at speeds adjustable in steps between 20 and 60mm/h.

d. The measuring range shall be changeable byplug-in modules.

e. The measuring value shall be got by multiplication between the read-out value and the integer.

f. ~~Recorders for electrical values shall be of the pen type and of accuracy class 1.5 and shall have a recording width of not less than 100mm. Flows, pressures and levels shall be recorded on line recorders, other types of measurements shall be recorded on multi-point recorders. Multi-point recorders shall be based on the microprocessor.~~

g. ~~The recording paper shall be of the same standardized type for all recorders.~~

h. ~~To protect input open circuit i.e. loss of input signal to the recorder, UP/DOWN scale protection shall be provided i.e. the pointer will go to either maximum/minimum of the scale.~~

1.2.18 Auxiliary Power Supply

1. The service power supply for use in the power plant shall be supplied through 3- Phase 4-wire, 415 V, 50 Hz AC supply.

2. AC supply for control & protection devices, lighting fixtures, space heaters etc. shall be through 240 V, 2-wire, 50 Hz, single-phase supply.

3. DC power supply for alarm, control annunciation and protective devices shall be through 220 V, 2-wire supply from battery charger/storage batteries.

The above power supply voltage & frequency may vary as under: -

1. AC Supply
   a. Voltage variation: – □10 %
   b. Frequency variation: □3 %

2. DC Supply: Voltage Variation - 85 % to 110%

Other AC/ DC voltage systems eventually needed, shall be generated from the above systems by means of dc/dc converters, inverters etc.

1.2.19 Cabling

1. Cabling and Conduits
   a. The control and power cables shall conform to IEC/BIS standards specified

the relevant Clause.

b. The Contractor shall furnish all control and power cables which will be used for controlling, operating and supplying power for equipment of the power plant, except those specified to be excluded from the scope of supply.

c. The cables shall not have cuts or scratches in the insulation or protective covering or in the conductors. No splices or soldering shall be made in the conductors and all connections shall be made only at the terminal blocks or at the terminals of the Equipment. All cables shall be marked by the Contractor at each end with cable markers attached by a cable code number after completion of cable installation. Cable schedules indicating the cable routes, rack number in which the cable is laid and cable codes shall be submitted by the Contractor before installation.

d. The conduits and accessories shall conform to NEMA standards specified in the relevant Clause.

e. All conduit bends shall be gradual and smooth to permit the pulling of insulated electrical wires and cables without undue stress or damage to the insulation covering or sheath. Ends of conduits shall be fitted with bushings in order not to injure the sheaths of cables or insulation coverings.

f. The conduits i.e GI pipes along with pulling wire, which shall be required along penstock for laying of LT power cables and OFC cable to BFV house / Forebay, shall be in the scope of Civil Contractor. Steel hooks including its embedment as required at IPS and BFV chamber for holding of power cables shall be in the scope of civil contractor.

g. Cable termination kits and all the components having low shelf life shall be supplied near the period of COD and if it gets damaged /expired due to delay or any other reason, then it must be provided by thecontractor.

2. Terminal Blocks and Wiring

a. Wiring of the control boards, cubicles, control center and control boxes for auxiliary equipment shall be 600V PVC insulation covering copper stranded wire 19 strands conforming to 2.5mm^2 or larger, except that the small wiring used in the semi-conductor circuits may be excluded. The Contractor shall submit any wiring different from above-mentioned standards for approval by the Project Manager.

All instruments, relays and auxiliary devices or equipment and accessories shall be furnished, mounted and wired, except for those specified in the relevant Clauses. The wiring thereof shall be connected by crimp-type terminals (AMP terminal), or threaded crimp-type terminals.

b. Both ends of low voltage wires shall be provided with the terminal number rings or tube, and the numbers shall be recorded in the wiringdiagrams.

c. The interior wiring shall be brought to terminal blocks installed at either the left or right of the equipment or control cabinets as specified in order to be connected easily to external cabling.

d. Each DC circuit shall be provided with a switch on each control board, cubicle, control center and control box or terminal block for easy detection of ground faults.

e. Screw type terminal block shall be used. It would be as per IEC-60947-7-1 and should be made of unbreakable polyamide 6.6 meeting clause $V0/V_2$ according to UL 94. All metal parts including screws should be made of copper alloy and non ferrous in nature. Its screw should be captive and shall have screw locking design to prevent loosening of conductor up to vibration level of 5g. The wire shall be terminated through hollow pin type stranded lug. It shall comply to latest ATEX and RoHS standards and will have universal mountings. The terminal blocks for current transformer secondary circuits shall be of the short-circuiting type. The terminal blocks shall be provided with a cover and the terminal numbers.

f. Each terminal block shall have marking strips, and shall be equipped with crimp- type terminals (AMP terminal) for $2.5mm^2$ or large to make connections with outgoing cables. The terminal blocks shall be provided with ten (10) percent but not less than ten (10) additional terminals as spares for each control board and cabinet besides the necessary number. Three (3) and more external wires shall not be connected to one (1) terminal.

g. The terminals of motors or other equipment shall have pressure compression type terminal lugs to which outgoing cables with crimped thimble shall be connected.

h. Ring type tinned copper thimbles shall be used for cable terminations of secondary circuits of Current transformers.

3. Color Coding of Wiring

a. The following color identification shall be applied to the insulation of wires used for internal wiring of control boards, cubicles, control center, control boxes and auxiliary equipment.

Secondary circuits of potential transformers	Red
Secondary circuits of current transformers	Black
DC circuits	Blue
AC circuits except power circuits	Yellow
Neutral	Light Grey
Ground	Green

b. Three (3) phase outgoing cables shall be color coded as follows:

Phase A	Red
Phase B	yellow
Phase C	Blue
Neutral	Light Grey
Ground	Green

c. DC supply shall be color coded as follows:

Positive	White
Negative	Black
Common	Green

d. If the Contractor's standard products have the difficulty to meet the above color sequence, he shall submit his alternative color schedule at the Bidding.

4. TerminationDiagram

a. Termination diagrams may be combined with equipment wiring diagrams. Termination diagrams shall show the following details for each cubicle, cabinet, device or other equipment to which cabling is to be connected;

i) the cubicle designation,

ii) all terminal strips or terminals in their correct relative location,

iii) a wire number (or blank space in the case of a spare terminal) against each terminal,

iv) for each cable, the cable identification number, the total number of cores and the number of spare cores and the designation of the cable,

v) the wire number of each core in each cable.

b. Termination diagrams shall make reference to the associated circuit diagram drawing numbers and wiring diagramdrawing numbers.

c. The information may be presented in schedule or computer printout form, providing that the schedules are accompanied by drawings showing the terminals and referring to the schedules to enable easy cable, core and terminal identification.

1.2.20 Electric Motors and MotorControls

1. Motors

a. All motors shall be in accordance with NEMA MG1/IS 325, suitable for continuous operation and direct on-line starting. The starting current at full voltage shall not exceed six times full load current. Motors larger than 746W shall be of three- phase type. Nominal voltage at the motor terminals shall be 415V AC for three- phase motors and 240V AC for single-phase motors.

b. All motors shall be capable of continuous operation at rated output, at any frequency between 47Hz and 53Hz, and plus or minus 10% of nominal voltage, at nominal frequency, without injurious overheating. In addition, motors shall not be affected by a transient frequency rise of 45% due to the load rejection of the units. The Contractor shall demonstrate compliance with these requirements to the satisfaction of the Project Manager.

c. Nameplates as detailed in equipment labeling (clause 1.2.8(2)) shall be provided on each motor.

d. With the exception of the submersible motors of drainage pumps, all other AC and DC motors shall be totally enclosed, with Protection to NEMA MG2.

e. Ball or roller bearings shall be used, and vertical motors shall have approved thrust bearings. Ball or roller locating cages shall not be in contact with the races.

Both end of sealing ball bearing, in which the motor capacity is below 35kW, shall be provided with the lubricated bearing for life.

Lubricating devices shall be provided for all bearings. Where ball and roller bearing housings are fitted with grease nipples they shall incorporate an approved grease escape valve.

f. The terminal box shall be weather- and vermin-proof and firmly fixed to the motor frame. The terminal studs shall be sized to be adequate for the current duty required and marked in accordance with NEMA ICS4 where applicable. All terminal boxes shall have approved cable adapter plates, sealing chambers or conduit entries.

g. The arrangement of the terminal box shall be such as to facilitate installation of cables, and allow interchanging of any two-phase leads, without disturbing the sealing compound, if this is used at cable terminations.

h. Means of isolation of motors shall comply with the National Electric Safety Code, ANSI C2.

i. Electric motors installed outdoors shall be protected for overheating by the sun by means of a canopy of approved design.

j. The motor end cover remote from the driving end shall have a removable plug to allow the speed to be checked by means of a portable tachometer.

2. Contactors and MotorStarters

a. The rated voltage, current and duty of contactors and motor starters shall be appropriate to the service conditions. Starters and contactors shall comply with NEMA ICS, be suitable for direct on-line starting and continuous electrical duty and be capable of 30operations per hour appropriate to the duty required. All starters should preferably be of one manufacture.

b. Individual enclosures with degree of protection not less than NEMA ICS shall be provided for all contactors and motor starters including those within cubicles. The enclosures shall be complete with locks, cable sealing boxes, conduit entries, cable gland plates, bus bars, internal wiring, terminal boards as required by the location and duty of the starter or contactor.

c. Contactors and motor starters of the electro-magnetically held type in addition to complying with American Standards shall comply with the following requirements:

- Operating coils shall be rated for 230V AC unless otherwise approved.
- At any voltage at which pick-up occurs the contactors shall close completely.
- With 70% voltage at the coil terminals the main contacts shall not chatter nor part when the starter current resulting from a stalled motor is being conducted.

d. All motor starting equipment for AC motors shall be protected by the thermal overload relay to each phase with ambient temperaturecompensation.

1.2.21 Electrical Relays

1. Relays shall be provided with non-flammable dust and moisture proof cases, and shall comply with IEC255 or ANSI/IEEEC37.90.

2. Relay elements shall be of the plug-in or withdrawable type and the plug-in connection shall be made and broken by pressure contacts. Where appropriate, the Project Manager will approve the use of cases containing multiple plug-in relay elements.

3. Relay contacts shall be adequately rated for the service conditions. The coils shall be continuously rated and shall have a tropicalised finish. DC operated coils of control and trip relays shall be suitable for operation at 220VDC in the range of 80% to 130% of nominal voltage.

4. It shall be possible to adjust the timing delays easily and the relays shall hold that adjustment. The timing range of the relays shall overlap the expected setting by at least plus or minus 50% unless the timing range is shown on a drawing included with the Specification. The setting adjustment shall be calibrated clearly.

5. At least one spare normally-open contact and one spare normally-closed contact shall be provided on each relay in addition to the contacts required by the control scheme.

6. Relays shall be direct acting as far as possible and interposing relays kept to a minimum consistent with consideration of the number of contacts required. The use of interposing relays shall be subject to the approval of the Project Manager.

1.2.22 Electrical Control Devices Manually Operated

1. The electrical control devices shall comply with IEC947-5-1.

2. The contacts in all electrical control devices shall be adequately rated for the service conditions. Contacts shall be silver or silver-plated except where the conditions of operation require the use of harder materials such as tungsten or where special contact assemblies are of gold or of the mercury-wetted type.

3. Switches shall have insulating barriers between adjacent contacts and shall have an overall protective cover. Contacts shall be readily accessible for inspection, maintenance andreplacement.

4. Control selector switches provided to select a particular mode of operation of plant shall, unless otherwise specified, have knurled circular type or similar handles and fixed operating positions spaced 90 degrees apart.

An escutcheon shall be fitted with the following information in the positions stated:

- Switch function (attop)
- Mode selected (opposite each switch position)
- Device number as shown on circuit diagram (bottomright)

5. Control switches, unless otherwise specified, shall be of three-position heavy-duty spring return-to-neutral type. Control switches for circuit-breaker and power operated disconnect switch OPEN and CLOSE control shall have pistol-grip handles. Selector switches shall have knurled circular type or similar handles. All other control switches shall have T Head handles or push-button switches with/without protection cover. These requirements do not apply to solid-state devices.

An escutcheon shall be fitted engraved with the following information in the positions stated:

- Switch function (attop)
- Control function selected (opposite each switch position)
- Device number (bottom right)

6. Direction of operation control devices shall be arranged toturn:

- Clockwise - for RAISE, CLOSE (contacts), START, USE, LOCAL ON and OPEN (valves) positions

- Anti-clockwise - for LOWER, OPEN (contacts), NOT USE, REMOTE, STOP, OFF, and CLOSE (valves)positions

7. Illuminated push-button switches (IPB) shall of the rectangular single button flush panel-mounted type using LED lamps. No fixing screws shall be visible from the front of the panel.

Where IPB's are gang mounted, barriers shall be fitted to separate the display screens.

Lens caps shall be translucent with one color field only, with separate legend inserts behind the cap.

A minimum number of two lamps shall be provided in each IPB. Colored lamps or colored sleeves over lamps shall not be used.

Lamp replacement shall be possible from the front of the panel.

Switch units shall have double-break contacts and be suitable for the service conditions.

IPB used in sequence controls shall give flashing indication when a change of state is in progress and shall change to a steady indication when the change of state has been completed. The flashing indication may be provided either by integral solid-state electronic pulse modules or by separate units.

8. Other push-button switches shall be of heavy duty type. Push-buttons, except those installed in control rooms and the like, shall be shrouded to prevent accidental operation. Push-buttons on electronic equipment are excluded from these requirements. Except where used in air-conditioned rooms, push-buttons shall be dust-proof and arranged to prevent the ingress of dust into any dust-proof enclosure.

   The colors for push-buttons shall be red for "on" push-buttons and green for "off" push-buttons.

1.2.23 Indicating Lights

1. Indicating lights shall be of the LED (Light-emitted Diode) type. Power source of indicating lamps shall be 230V AC from UPS or220VDC.

2. The fittings shall withstand 500V DC for one minute and shall be so constructed that the lamp can be readily fitted and removed and the lens changed from the front of the panel.

3. The fittings shall be capable of continuous operation at the nominal lamp voltage regardless of the position in which they are mounted. The lamp supply shall be

derived from a suitable transformer on each panel, or suite of panels, on which indicating lights are fitted.

4. Lenses shall be of translucent glass or other approved material. Plastic lenses will be accepted if fitted with a robust anti-shrink ring or other approved device to prevent the lenses becoming loose due to deformation or shrinking. Where color indication is required, colored lamp covers are not acceptable.

5. Lamp-holders shall be made of metal or an approved high grade plastic material. Plastic used in the lamp-holder body or for clamping rings shall be dimensionally stable to a degree such that jamming of threads shall not occur during normal service.

6. Terminals shall be studs or screws suitable for the connection of ring-tongue wire terminals and shall be provided with suitable lock washers. Pinch-screw terminals will not be accepted.

7. Indicating light color indications for electrical circuits and valves shall be red for "on" or "open", respectively, and green for "off" or "closed", respectively.

1.2.24 Electronic Equipment Assemblies

1. General

a. All inputs to electronic equipment which are derived from sources in close proximity to other equipment operating at voltages higher than the breakdown voltage of the electronic equipment shall be isolated by an approved means.

b. All outputs from electronic equipment which are routed in close proximity to other equipment operating at voltages higher than the breakdown voltage of the electronic equipment shall be isolated by an approved means.

c. All cabling to electronic equipment shall be terminated on U links equipped with test sockets arranged to allow for testing input condition with U links in site. Visible indication of input conditions should where possible be displayed on LEDs in series with the input circuit.

d. Electronic equipment such as amplifiers and logic circuits shall be of solid state design using industrial or military grade discrete transistors or integrate circuits, bearing EIA registered device numbers. Components shall be suitable for long-term operation at temperatures between -6°Cand45°C.

e. Electronic equipment shall be immune from false operation or failure from the electrical noise caused by electromagnetic interference (EMI) or radio frequency interference (RFI) that may be induced in the control circuits and power supplies internal and external to the equipment. Special precautions shall be taken to limit exposure of sensitive electronic circuits against any noise source or keep an adequate distance. An effective grounding and shielding system shall be established for the equipment and cabling. PI/O circuits, power supply unit and other susceptible circuits shall be optically or electrically isolated. IEC 801-3 "Electromagnetic compatibility for industrial-process measurement and control equipment, part 3: Radiated electromagnetic field requirements" shall be applied for the design of anti-noise capability.

f. All inductive devices, such as relay solenoids shall be provided with suppression devices to limit surge voltage that may be generated when the coil circuits are interrupted.

g. The relay system shall be designed and tested for surges withstand capacity in accordance with ANSI/IEEE Std. C37.90.1 "Relays-Surge Withstand Capability (SWC) Test". In addition, IEC 255-22-3 shall be applicable for Electrical disturbance tests for measuring relays and protection equipment

2. Printed Circuit Card Frames and Wiring

a. The printed circuit (PC) cards shall be assembled in frames, which when mounted in racks or cubicles shall give full clear front and rear access to the cards and their connectors. Where it is necessary to mount equipment at the rear of card frames, the mounting shall be arranged on hinges to facilitate access to the card frames and wiring.

b. Card frames shall be equipped with locking devices to prevent the unplugging of boards due to vibration or accidental disturbances.

c. If cable plugs are connected to the front of PC cards or in any case where there is movement of the plug or socket relative to the attached cable, the cable shall be of a stranded type for this purpose.

d. Soldering shall not applied on wires wrapped around and similar pins not designed for soldering wrapping terminals.

e. With drawable cards, modules and cable plugs shall be keyed, coded or otherwise marked to ensure there is no possibility of replacement in the wrong position.

3. Printed Circuit Cards

a. Printed circuit cards shall be of good quality fiber glass. The PC cards shall be flow soldered and covered with protective enamel adequate to protect the card from gasses such as hydrogen sulphide likely, to be encountered on site. Components and test points shall be clearly labeled. Type number, serial number, and a reference to the relevant drawing number shall be clearly labeled on the PC card. Such labeling shall be of a permanent nature and shall withstand cleaning with Freon or similar solvent.

b. Preference will be given to boards equipped with modular edge connectors rather than those using an extension of the printed circuit track as a male plug. Contacts of printed cards shall be gold plated.

c. Components shall not be used as through-connectors. If through-hole plating is not employed, separate through-connectors shall be provided by track connecting pins.

4. Components

a. The following information shall be supplied prior to installation for each component used:

- Name of manufacturer/distributor
- Name of second source manufacturer/distributor
- Data sheet giving the complete specification for the component.

b. All components shall be of proven reliability and shall be conservatively rated. The surface temperature of any component shall not exceed 70^0C at an ambient temperature of45^0C.

c. All components shall be of standard ranges which can be expected to be continually available from more than one product source.

d. All signal and supply voltages, currents, impedances, timing and other environmental conditions for each component or assembly shall be designed to be well within the limits specified by the component manufacturer.

5. Microprocessors

a. Where microprocessors or similar programmable or pre programmed circuits are employed, the Contractor shall supply the following:

- Flow charts
- Software
- Copies of all information required to purchase and program the system or to replace components. A control panel allowing testing of all functions performed (with facilities to run, single step, display register, display memory, change program counter, etc.).
- Facilities for reprogramming

1.2.25 Enclosures for Electrical Equipment

1. Enclosures complying with this Clause shall be provided for assemblies of items such as electronic equipment, indicating instruments, control, alarm and protection devices, indicating lights, electrical relays, switchgear and high voltage equipment and wiring terminations. Except where otherwise specified, the enclosures shall comply with IEC298 or ANSI/IEEE C37.20 as supplemented by NEMA SG-5.

2. Sheet metal enclosures shall be constructed of folded and welded sheets of thickness which is appropriate to the size of the enclosure. The thickness shall not be less than 3.2mm for floor standing cubicles and 3.0mm thickness steel for all other enclosures. Rolled steel sections may be used in large cubicles for forming the frame and stiffening. Where equipment is to be mounted on a panel

the thickness of the sheet steel shall be sufficient to prevent vibrations affecting the correct operation of the equipment. To prevent warping of panels, all heavy devices shall be supported by means of rear mounted brackets or straps.

3. Doors shall be provided where access is necessary during normal operation of the plant, e.g. for replacing fuses, resetting relays, taking equipment out of service or routine inspection of contactors, relays or similar equipment, but where access is necessary only for cleaning or repair, or to equipment such as current transformers, removable covers may be provided. Where a removable cover is provided which is larger than that can be handled by one man working alone then hinges shall be provided. Since, the oil filled generator transformers shall be kept in individual encloser, automatic fire door shall be provided towards cable gallery and front of Generator Transformers.

4. a. The Contractor shall ensure that clearance from an open enclosure door to adjacent walls/column or equipment shall be 1000 mm for enclosures under 3m long and 1200 mm for enclosures over 3m long. For enclosures exceeding 3.5m long, access to the area behind the enclosure shall be available from both ends of the enclosure.

   b. Every main switchboard shall comply with the following provisions of Indian Electricity Rule –1916 (rule51)

   i. A clear space of not less than 0.914 m (3 feet) in front of the switchboard shall be provided.

   ii. If there are any attachments or bare connections at the back of the switchboard, the space behind shall be either less than 0.229 m (9 inches) or more than 1.0 m (40 inches) in width measured from the farthest point. In the later case, there shall be a passage way from either end of the switchboard clear to height of 1.829 m(6feet)

5. Furniture on doors shall include substantial hinges of the lift-off type and provision for positive latching with locking lever handles. Locks shall be cylinder locks in handle type. Floor standing enclosure doors shall have internal extension mechanisms fitted to the handle to latch positively at the top and bottom of the door.

6. The arrangement of equipment in and on the enclosures shall be such that maintenance can be carried out easily without dismantling other equipment.

Equipment mounted on doors shall be kept to a minimum and no electrical relays shall be mounted on doors. Enclosures shall be arranged so that devices requiring manual operation are mounted at a height between 750 mm to 1500mm above floor level.

7. Separately mounted devices shall be enclosed with the degree of protection not less than designation NEMAICS.

8. Detachable gland plates of sufficient size and number shall be provided for either top or bottom cable entry or both, except that outdoor enclosures shall not have top entry. Gland plates for single core cables shall be of non-ferrous material. Floor mounted indoor enclosures may have their bottom entry gland plates substituted by channel mounted cable clamps for cable support. Alternative methods for prevention of vermin entry is required where channel mounted clamps are provided. Equipment shall be mounted on enclosures when armored multi-core cables areused.

9. Tubular space heaters of adequate capacity and suitable for connection to single phase, 230 volts, 50 Hz A.C. supply shall be provided inside each panel to prevent condensation of moisture on wiring and panel mounted equipment when the panel is not in operation. These heaters shall not be mounted close to the wiring or any panel mounted equipment. Heaters shall be complete with isolating switches, HRC fuses on phase and link on the neutral of heater supply and its switching shall be controlled by thermostat. Minimum size of the cable used for heating circuit shall be 6 mm^2 copper cable. The rating of the heaters shall be 20W for each square meter of exposed surface area of the enclosure. The surface temperature rise of the heaters shall not exceed 100 eaters shall be mechanically protected and live parts shrouded.

   Where the heat produced by the equipment during normal operation is equal to or greater than the output of the heater then the heater shall be switched off automatically. All heaters shall be provided with expanded aluminum covers to prevent accidental touching.

10. All enclosures fitted with anti-condensation heaters shall have ventilation openings in the doors which shall be screened with vermin-proof fine brass gauze or a suitable filter and arranged to minimize entry of dust and prevent entry of water. Sealing of doors and covers shall be by closed cellneoprene

foam sections on to surfaces at least as wide as the sealing section; estafoam type material is not acceptable for seals.

11. Luminaries shall be provided to light the inside of each enclosure large enough for a man to work inside. Luminaries shall be controlled by a fully enclosed door- actuated switch. Enclosures with 450mm or larger roof overhang shall be provided with fluorescent luminaries fitted under the extremities for the roof. Such luminaries shall be controlled by a manually operated switch at one end external to the enclosure.

12. Where an enclosure contains fluids under pressure, compartments shall be provided to prevent damage to equipment by fluid leakage or discharges.

13. Finish painting inside enclosures shall be stove enamel white and the finished surfaces outside shall have stove enamel smoke gray shade 692-IS-5 and shall present a first class appearance free from all blemishes, of uniform color to adjacent enclosures. Equipment contained in enclosures shall be finish painted as if it were exposed to view. Base of frame shall be painted stove enamel black.

14. All enclosures not located in an air-conditioned atmosphere shall be sealed to prevent corrosion of inside equipment and instruments by hydrogen-sulphide gas.

15. The Contractor shall assign an alphabetic abbreviation to each enclosure included on his drawing and diagrams. The cubicle abbreviations shall be subject to approval. A label showing the cubicle abbreviation shall be provided on the outside rear or cabling side of each enclosure. Cubicle abbreviations shall incorporate the unit number where appropriate.

16. Anti-vibration facilities such as dumping pads at the foundation base shall be provided if the excessive vibration is expected. In the design of anti-vibration, an attention shall be paid not to cause any excessive sway of the cubicle amplified with the resonance between the cubicle's natural frequency and that of vibration source.

17. Where two or more panels are installed side-by-side, necessary arrangement shall be made for bolting together the adjacent panels. Where matching of

the panels with panels in the supply scope of other contractors is required, the details of existing panel shall be furnished to enable matching of panels.

18. The panel/board shall be completely enclosed to ensure dust, moisture & vermin proof atmosphere. The panel/board shall be designed for the degree of protection in accordance with IEC-529.

19. No equipment shall be mounted on the doors without prior approval of the Purchaser

~~1.2.26 Display of Mimic Diagram on plasma/LCD screens~~

~~1. Colored mimic diagram and symbols showing the exact representation of system complete with symbols and colors strips to represent the buses, transformer feeders, semaphore for isolators, circuit breakers shall be displayed on the monitors.~~

~~2. The colors for various voltages in the mimic diagram shall be as per relevant standard.~~

1.2.27 Insulators

The bushings, insulators and porcelain housing used in the Equipment shall have sufficient mechanical and electrical strength and shall meet the requirements of IEC 137, 587 or ANSI 29.

1.2.28 Grounding

1. The ground terminals of the Equipment shall be of the bolt-fastened type, suitable for hard drawn copper stranded conductors.

2. The minimum sizes of earthing conductors required for various equipment shall be covered under Grounding System Design. The details and number of ground terminals shall be approved by Project Manager.

3. For grounding connections in connected cubicles, such as unit control boards, switch boards, control boards etc. in the control room/machine hall, etc.,

ground bus of copper bar not less than 6mm by 25mm size shall be provided along the inside of the front or rear of each cubical and equipment rack. This bus shall be connected solidly from one cubicle to another adjacent cubicle. The ground bus shall be bolted to the frame of each panel in such a way as to make good electrical contact with each panel or section. The secondary circuits of instrument transformers and shielded tape of cables, etc., shall be connected to earthing bus of cubicles. Lugs shall be provided for connection of the ground bus to the station ground bus/earth mat.

1.2.29 Inspection andTesting

1. General

All materials and components shall be subject to the tests and inspection specified in this Contract and to such other tests and inspections as may be necessary to clearly demonstrate compliance with the Specification.

2. Non-Destructive Testing

Unless otherwise specified, non-destructive testing shall be carried out in accordance with the latest edition of the following standards:

a. Castings

- Radiographic examination

ASTM E 446	minimum quality levels: 2 except for category A for which the minimum quality level shall be 3
ASTM E 186	quality levels as above
ASTM E 280	quality levels as above

- Ultrasonic examination

ASTM A 609/A 609 M	minimum quality level 2

- Magnetic particle examination

ASTM E 125	minimum quality levels: type I degree 1, other types degree 1

- Dye penetrantexamination

ASTM E 165	evaluation to be agreed upon at the inspection and the acceptability will be subject to agreement between the Project Manager and the Contractor.

b. Forging

- Ultrasonic examination

ASTM A 388	acceptance of recordable indications shall be at the Project Manager's discretion.

- Magnetic particle examination

ASTM A 275	acceptance subject to agreement between the Project Manager and Contractor.

c. Plates

- Ultrasonic Examination

ASTM A 435/A 435 M

d. Welding

Welds shall be tested according to the requirements of ASME Section VIII Table UW-12 unless otherwise specified herein.

Watertight welded joints shall be 100% tested by magnetic particle or dye penetrant.

The Contractor shall indicate on the Fabrication and Installation Drawings the type of non-destructive testing to be conducted.

The following requirements shall be apply:

- Radiographic Examination: according to ASME Section VIII para UW-51 and for spot examination according to ASME Section VIIIparaUW-52.

- Ultrasonic Examination: according to ASME Section VIII Appendix 12. Ultrasonic examination will be considered equivalent to radiographic examination for the purpose of the weld efficiency factor determination, provided that the following conditions are met :

Welds with indications exceeding 50% of the reference level shall be radiographed in accordance with requirements ASME Section VIII para UW-51; in addition, 10% of the shop welds and 20% of the field welds shall be radiographed.

Crossing point welds shall be 100% radiographed.

Should a single unacceptable defect be found out, the whole group shall be radiographed without considering these radiographs as included in the above percentages.

Radiographically examined welds shall have identification marks which appear in the radiographic film. The marks shall not be removed before the weld has been approved by the Project Manager.

All radiographic film of welds shall be submitted for approval together with a location map of the identification marks. Radiographic films shall become the property of the HPPCL. Weld defects shall be removed and repaired to the satisfaction of the Project Manager. Repair procedures shall be submitted for review.

3. Repair of Defects

a. Casting

The Contractor shall advise the Project Manager of the schedule for the casting of the important pieces for which the inspection of the casting defect is required. The Project Manager will inspect these items after casting before any repair work. Castings requiring welding repairs and castings involving welding fabrication shall be stress-relieved unless otherwise permitted by Project Manager. No welding shall be done after final heat treatment without the written approval of the Project Manager. Weld repairs shall be re-inspected. A large number or size of defects maybe cause for the rejection of the casting if, in the opinion of the Project Manager, its strength will be affected by the defects.

b. Forging

All main forging shall be ultrasonically tested. Excessive concentration of impurities or separation of alloying elements at critical points will be cause for rejection. Welding repairs shall be approved by the Project Manager and shall be carried out in accordance with ASME Code Section VIII.

c. Steel plates and sections

Main parts subject to the water pressure and/or stress carrying such as inlet valve body, inlet valve rotor, spiral case, stay ring, head cover, bottom ring, etc., shall be 100% ultrasonically examined for lamination defects. All tests shall be performed before the start of fabrication and the results submitted to the Project Manager for approval.

4. Material Mechanical Tests and Chemical Composition

a. All principal materials such as plates and sections subject to intermediate and high stresses, main castings and forging shall be subject to the mechanical tests prescribed by the relevant Standards. Where no definitive specifications are given, test pieces shall be obtained as required by the Project Manager.

Test specimens and samples shall be plainly marked to indicate the material they represent and, if required, shall be properly boxed and prepared for shipment.

Mill test shall be done for all principal materials to gain the chemical composition and physical properties.

b. The Contractor shall furnish copies, as specified, of all mill certificates, material test certificates and welding rods certificates. The test certificates shall be suitably identified with the component parts for which the materials are to be used and shall be prepared in such a way that it can easily be determined, if the applicable specifications or standards have been complied with.

5. Dielectric Test at the Site

Regardless with the specified dielectric test voltage for the Equipment, the following test voltages will be applied for each circuit at the Site, so the Contractor shall be design the low-voltage equipment to meet this requirement.

For 415 V A.C. power circuits and 230 V A.C. power circuits	2,000 V A.C., one min.
For 220 V D.C. power circuits	1,500 V A.C., one min.
For control circuits (except for electronic equipment)	1,500 V A.C., one min.

1.2.30 Tools andEquipment

1. Every O&M tools shall be accompanied or furnished with maintenance or instruction manual.

2. Except where otherwise specified, all equipment/tools shall be suitably arranged in metal tool boxes, each fitted with a lock with two (2) keys. The tool boxes shall be painted black and clearly marked in white letters with the name of the equipment to which the tools therein apply, and with a list of the tools contained, stamped on an attached metal tab.

3. If the weight of any box, or its size, is such that it cannot be conveniently carried, it shall be supported on steerable rubber tired wheels. All large tools and

wrenches shall be mounted on a suitable shadow board arranged for wall mounting.

1.2.31 Spare Parts

Spare parts shall be packed for storage in the climate at site. Each part shall be marked with its description and purpose on the outside of the packing. If the special care is required to keep the performance of the spare parts, those requirements shall be clearly indicated on the packing with full details and maintenance manuals.

1.2.32 Packing

1. Rubber parts shall be protected against light and air. Moisture absorbent crystals shall be included with all items enclosed in plastic of other impervious material.

2. Equipment mounted relays, instruments, etc. shall be removed and separately packed.

3. Shafts running in ball or roller bearings shall be packed so are relieved of the weight of the rotating parts.

1.2.33 Climatic Condition

1. General

   a. All materials and equipment supplied under these specifications shall be suitable for being delivered, stored and operated under climatic conditions of high temperature, high humidity, heavy rainfall, environment of rich mildew and fungus.

   b. Countermeasure procedures shall be in accordance with the best commercial and industrial practices.

   c. The Contractor shall submit the details of his usual practice which have been proven as satisfactory and with which he recommends for application to the parts maybe damaged under the climatic conditions.

2. Specific Requirements

a. Metals

Iron and steel shall be painted, galvanized or metal-sprayed as appropriate. Indoor parts may alternatively have chromium or copper-nickel plating, or other suitable protective finish. Dissimilar metals in contact which may cause galvanic corrosion shall be insulated from each other by a suitable insulating material or a coating of varnish compound.

b. Bolts, screws, nuts

Steel bolts, screws and nuts shall be zinc, chromium plated or of corrosion-resisting steel. Corrosion-resisting steel, copper-nickel alloy or bronze shall be used for bolts and nuts subject to adjustment or removal.

c. Fabrics, cork, paper, etc.

Fabrics, cork paper and similar materials, which are not subsequently protected by impregnation, shall be treated with suitable fungicide. Treatment with linseed oil varnishes shall not be used.

d. Adhesives

Adhesives shall be impervious to moisture, resistant to mold growth and insects. Waterproof synthetic resin glue only shall be used for joining wood. Casein glue shall not be used.

e. Electrical material and equipment

Materials and components which are fungus resistant or are protected by hermetic sealing or oil immersion need not be treated. Other elements shall be protected by additional varnish for high humidity and given an anti-fungus treatment.

All switchgear and control boards shall also be rodent and vermin proof.

1.2.34 Equipment Installation and Erection

The Contractor shall comply with the specifications provided the installation manual and field-test plan.

1. General

   a. The Contractor shall be responsible that the installation of all equipment is properly executed to the correct lines and levels, which shall invariably be got, confirmed from the control survey unit of the project and in accordance with the manufacturer's instructions and the Contract requirements.

   b. The alignment of the equipment shall be done exactly; the tolerances indicated by the Manufacturers or in the drawings shall be kept.

   c. Setting of parts to be aligned shall be performed by means of fine measuring instruments. All erection clearances and settings shall be recorded. Copies of these records shall be given to the Project Manager. After alignment, the parts shall be held firmly in position by means of set pins, fitted bolts, etc.

   d. Anchor bolts, base plates, anchor rails, etc. to be embedded in the first stage concrete shall be delivered in due time with instructions and/or templates to facilitate the bringing in of such parts into the Civil works.

   e. All parts to be embedded in concrete shall be set accurately in position and shall be supported rigidly to prevent displacement during the placing of concrete. Adjusting screws and bolts shall be drawn tight and secured adequately. Steel wedges shall be secured by welding. Wooden wedges shall not be used.

   f. The Contractor shall verify carefully the position of all parts to be embedded before concrete is poured. All important measurements and dimensions shall be recorded. Copies of these records shall be given to the Project Manager for checking and approval before grouting.

   g. The Contractor shall be responsible for the supervision of the grouting work. He shall state the allowable filling velocity/pressure and

sequence for pouring the concrete in the different places. After concreting, the control measurements shall be verified again, indicated in the above mentioned records and submitted to the Project Manager.

h. Any error in shop work which prevents the proper assembling and fitting of the parts shall be immediately called to the attention of the Project Manager and approval obtained for the correction procedures.

i. The Contractor shall provide all necessary anchors and braces to ensure the alignment and stability of the parts to be installed. All temporary anchors and braces shall be taken care of all dead load, wind load, seismic and erection stresses, e.g., during concreting, and shall remain in place until they can be removed without endangering the stability ofthe equipment.

j. Welding, torch-cutting and drilling work on the equipment to be erected shall only be carried out with the approval of the Project Manager.

k. If for installation purposes auxiliary structures have been attached to the equipment, they shall be removed after completion of work and the surface restored to proper condition by grinding and repainting.

l. Special care shall be taken not to damage surfaces of galvanized or specially treated equipment during erection. Care shall be taken to prevent or remove any rust streaks or foreign matters deposited on galvanized or otherwise finished surfaces during storage or transport or after installation.

m. Glass parts or other parts which can easily be damaged shall be provided with suitable protective sheaths or coverings during installation.

n. Machined or bright surfaces which are to receive no coat of paint shall be protected during storage and erection by a suitable anti-corrosion film.

o. The equipment or parts to be installed shall not be over-stressed during the process of installation.

p. All portable power tools shall preferably be operated pneumatically. They are to be handed over at the end of the installation work in good condition

in accordance with the Project Manager's instructions.

q. After erection, the works shall be finally painted; it shall be done as far as applicable in accordance with the painting specification, and any damaged paint work shall be restored.

r. Rotating shaft couplings shall be checked for lateral and angular misalignment of the flanges and for total run out of the shaft before final connection.

s. Close clearances between running and stationary parts shall be checked at several points around the circumference.

t. Components filled with oil such as piping, valves, bearings, and tanks shall be cleaned by oil flushing before thefirst filling.

2. Tolerances

a. The equipment shall be installed to the dimensional tolerances given in the Technical Specifications and/or the approved Installation Drawings and Instructions.

b. Any tolerances stated in the Technical Specifications are for the erected equipment.

c. Installation tolerances shall be detailed in the Installation Drawings and Instructions submitted for approval.

3. Materials for the Installation Works

The following materials shall be furnished by the Contractor:

a. Supporting structure and the steel materials to hold the structure in place during installation work

b. Oil required for installation work, such as for washing and cleaning machines and other uses

c. Anchor hooks, foundation bolts and other materials for the Installation Works shall be furnished within the enough advance time, especially for

such materials to be embedded in the slab, ceiling and floor of the first stage concrete shall be placed according to the construction schedule of the project

d. Other necessary materials for the InstallationWorks.

1.3 General Requirements for Technical Document

1.3.1 General

1. This Chapter specifies the general scope and gives a definition of the documents shall be delivered by the Contractor to the Purchaser/Project Manager within the periods, and in a number and quality as specified in the Section-6 of Volume I.

2. The Project Manager reserves the right to request from the Contractor additional documents as may be required for proper understanding and definition of constructional, operational, coordination or other matters.

3. The Contractor shall cooperate with other contractors in the exchange of drawings, dimensions, data and all other information required to ensure proper coordination of the work. All documents to be supplied shall be submitted in time so that any comment and change requested by the Purchaser/Project Manager can be taken into account before starting of the manufacture in the workshop and or erection or installation at site.

4. If the Contractor fails to submit such documents, then the later execution of changes requested by the Purchaser/Project Manager and the resulting additional cost and/or delays shall be the Contractor's responsibility. The Contractor shall not be released of his responsibility and guarantee after drawings and computations have been approved by the Project Manager.

5. The preparation of drawings, computations or other technical documents shall not be sublet by the Contractor without the written authorization of the Project Manager/Purchaser. In such a case the Contractor has full responsibility as if they were done by contractor himself.

6. On drawings, catalogue sheets or pamphlets of standard equipment submitted to the Project Manager the applicable types, paragraphs, data, etc., shall either be marked

distinctively or the non-applicable parts be crossed out. Documents not marked in such a manner will not be accepted and approved by the Project Manager.

7. If required for proper understanding of the documents, additional descriptions/explanations shall be given on these documents or on separate sheets. All symbols, marks, abbreviations, etc., appearing on any document shall clearly be explained by a legend on the same document or on an attached sheet.

8. Each device appearing on any document (drawing, diagram, list, etc.) shall clearly be designated. The abbreviation mark used for an individual device shall be identical throughout the complete documentation so as to avoid confusions. All documents shall have a uniform title-block as agreed by the Purchaser/Project Manager, irrespective of the origin of the document, provided with an approved identification number.

9. Revised technical documents replacing previously submitted documents shall be marked accordingly. Also, the revised part in the Document itself shall be marked clearly.

1.3.2 Submission of Drawings and Data

As soon as possible, however, not letter than 60 days from Commencement Date, the contractor shall submit the following drawings and data to the Project Manager for approval

1. Preliminary Assembly drawings of the whole of the Electromechanical Equipment showing construction of main components, governing dimensions and masses.

The Contractor shall also submit detailed information and schedules on the supply content of each system and ancillary related thereto.

2. General Arrangement Drawings

a. The general arrangement drawings shall shown overall arrangement of the equipment, major dimensions, and clearance heights for the Electromechanical Equipment, weight, description and location of all accessories, and other details to enable Project Manager to check the suitability of the arrangement, and to coord[illegible] with the other contractors for foundations, piping and cableconnections.

b. These drawings shall not substantially differ from the drawings enclosed in the Contract Documents and shall include plants and cross sections, showing the general construction and overall dimensions of all maincomponents.

c. Additionally the Contractor shall submit as soon as practicable general arrangement drawings of the Site workshop if it is necessary.

3. Drawings and Data for Embedded Parts and Civil Works-Design

a. These drawings shall include all dimensions and details required for the installation of embedded parts for permanent fixing or erection purposes, and the design of Civil Works.

b. The embedded parts shall include draft tube piping, supporting structure, base bolts, electrical conduits, grouting pipes, etc. Requisite stress-handling supports such as bracings/brackets etc, where involved e.g. in draft tube shells, shall not be removed unless the embedded part is securely set in the concrete/mortar.

c. These drawings, besides relative calculations and instructions, shall indicate the necessary data relating to loads and stresses for the basements, both for erection and for the operation: they shall also indicate all the necessary details, such as dimensions and details of foundation, block-outs, embedded items, grouting required, and size, type and project of anchor bolts, trenches for cables and pipes, catwalks and supports, and any other data necessary for the adequate design of the Civil Works.

d. Drawings and concrete loading data to complete the Civil Works-design, including dimensioned outline drawings, sole plate locations, details of sole plate, loading data, anchor bolt-setting tolerances, and all drawings showing necessary recesses required in the following and pipe- and cable-layouts, shall be submitted to the Project Manager for approval as per schedule given in the Section-6 of Vol.I.

e. The Contractor shall coordinate his design with the Civil Works-drawings, which will be forwarded to him, and shall give prompt answer to any request relevant to the Civil Works-design. The Purchaser will not accept Contractor's claims for the additional cost in case that at any time modifications to his drawings are required in order to meet the requirements of the Civil Works-design, even if the Contractor proves that such modifications will affect the equipment under construction or already manufacturedin

accordance with the approved drawings and time schedules, or else, if necessary, the manufacturer shall bear the entire cost of remodeling the constructed civil works to suit the requirement of the already manufactured equipment.

f. After approval by the Project Manager the above mentioned documents shall be considered as final and no modifications shall be introduced by the Contractor.

1.3.3 Mechanical Assembly-Drawings

1. General Requirements

a. The Contractor shall submit mechanical assembly-drawings covering the overall construction and outline with dimensions of all Electromechanical Equipment included in the works. These documents shall be submitted in sequence of importance, starting with the main equipment and following by minor items. These assembly drawings shall be match with those used in installation manual.

b. In all drawings for assembly each component shall be given a reference number and a list of all the parts/components shall be attached. The list may be pat of the drawings or given separately according to the Contractor's practice. For each component, whether custom-built or standard, the following main information shall be supplied as applicable:

- Number of parts
- Name of parts
- Weight
- Trademark
- Type
- Main characteristics

The main information so provided shall, in all cases, enable Purchaser to order replacement-parts without risk of errors.

For mechanical equipment incorporating electrical or other accessories, such as electric motors, indicators, detectors, recorders, relays, switches, etc., a special list shall be established and submitted for approval and coordination with associated Equipment.

The list shall at least indicate for each item in scope:

- Reference number
- Nature and functioning
- Location
- Type
- Main characteristics (voltage, capacity, output,

etc.) The list shall be adapted as necessary.

The drawings shall contain the following information:

- details of manufacturing and treatment of major single work pieces specially manufactured for this Contract;
- assembly of the equipment in plan and elevation with main dimensions;
- sub-assembly of the principal components of the equipment with overall dimensions, adjustment and clearance tolerances, numbers of corresponding detail drawings;
- sub-assemblies in which the Contractor proposes to ship the equipment;
- all necessary details of the parts connecting to equipment supplied by others;
- location and sizes of auxiliary connections for oil, grease, water, air, etc.;
- methods of lubrication and sealing;
- instructions for heat treatment (if any), pressure tests (if any), surface preparation and anti-corrosive protection;
- full details of parts for which adjustment is provided or which are subject to wear;
- method and sequence of installation, field joints, erection and lifting devices, jacks, grout plugs, anchoring details, etc., if not shown on foundation drawings.

2. Installation Drawings

The mechanical or electrical Installation drawings shall provide detailed information on the disposition of the various auxiliary items to be attached to the Equipment at the erection work (e.g. lighting fixtures, socket outlets, connection boxes, transmitters, actuators, loudspeakers, telephones, pipes, valves, pumps, compressors, etc.) and of the piping and wiring respective comprised in the installation or assembly. They shall be based on dimension drawings of cubicles, rooms, buildings or areas containing the equipment.

3. Detailed Drawings

These drawings shall include all details of equipment, including pipe details, supports for pipes, conduits and fittings, cable laying, cable rack connection diagram, bills of material, cable lists and any other detailed drawings required for manufacturing and/or installation. These drawings are to be cross-referenced to all other drawings.

4. Drawings of Parts Subject to Wear

Exactly scaled drawings of all components/parts, which required replacement due to wear in normal operation. The drawings shall include notations as to specifications of material for fabrication of replaceable parts.

The items will be decided after award of the Contract.

1.3.4 Electrical Drawings and Diagrams

1. All schematic diagrams indicating the operation and functioning of all electrical equipment, including single-line-diagrams, logic sequential diagram, back-wiring diagrams of control and protection and signaling circuits, accompanied, where necessary, by data, calculations and explanatory notes, shall be submitted to the Project Manager for approval immediately on completion of design and in connection with all other documents for the respective equipment.

2. For electrical diagrams general reference is made to IEC113-1.

3. Graphical symbols for diagram shall be in accordance with IEC 617 series.

4. Single-Line Diagrams

This is a simplified diagram of the essential electrical equipment and their interconnections. All circuits shall be represented by a single line only. It shall contain all required technical information of the equipment represented, e.g. device number, voltage, amperage, capacity, short-circuit level, ratios, voltage variations, positive and zero sequence impedances, measuring transformer and protection relay indices, interlocking, kind of switch drive, etc.

5. Three-Line Diagrams

To complement the single-line diagrams, three-line diagrams shall be provided for showing the actual connecting conditions between the devices.

6. Sequential Diagrams

a. The sequential diagrams shall be provided for showing the sequential operation of all protective relays, auxiliary relays, timers, contactors, indicating lamps, manual switches, proximity switches, etc.

b. The individual circuits are to be drawn in a straight line sequence, avoiding line crossings. The current paths (to be designated by numbers) shall be drawn starting from two horizontal lines which represent the control voltage source. All devices belonging to the equipment or forming part of the equipment or control devices shall appear between these two lines.

c. Contact developments of the installed switches, contactors, relays and other apparatus which appear in the diagram shall be shown below the respective contactor coil, indicating by means of numbers and, if not on the same, also the page number, the current path in which the corresponding contact has been used. Interconnections to other circuit diagrams shall be clearly marked by means of dotted line separations and the corresponding functional designation.

d. Sequential diagrams shall also contain all terminals and their correct designations. Terminals grouped together to terminal blocks of switchboards, distributors, etc., shall be shown on the diagrams. If, for any reason, the current paths of circuit diagrams

must be separated, the corresponding counter terminal has to be indicated by all means.

7. Block Diagrams

a. The block diagrams shall be used to show in a simplified manner the main inter-relationships between the elements of a system by means of symbols, block symbols and pictures without necessarily showing all the connections. The symbols used for the individual kinds of components, e.g. servo-motors, amplifiers, computing modules, etc., shall clearly be explained on the diagram or on an attached legend.

b. When required, a block text diagram may be prepared, consisting essentially of explanatory texts enclosed in outlines which are linked by lines showing the functional relationships that exist between the various parts of an installation, equipment or circuit.

8. Logic Diagrams

a. The logic or functional diagrams shall be used for representation of logic and sequence controls and interlocking by showing only binary logic elements and their effect on the various processes, equipment disregarding their electrical realization. Logic function elements (AND, OR, NOT, etc.) shall be used for processing and combining binary signals.

b. Necessary legends and outline descriptions of functions shall be indicated on the diagrams showing conformity with the specified requirements.

c. The logic flow diagram of programmable controller shall be accorded with the actual display on the programloader.

9. AC Schematic Diagrams

All diagrams shall show AC connections such as AC supply to all metering and relaying equipment, synchronizing schematic diagrams, etc.

10. DC Schematic Diagrams

All diagrams shall show the DC wiring for control, indication, annunciation, protection, etc., arranged in a schematic form and shall include the necessary wiring of all power circuit breakers that receive trip signals from the protective relays.

11. PI/O Interface Diagrams

All inputs and outputs of computer and programmable controllers shall be identified with the name, use, protection method (photo-diode, insulating transformer), signal type (digital/analog), voltage and current range, etc.

12. Wiring Diagrams

The internal connection or wiring diagrams shall show the wiring or tubing connections either within one apparatus or between several apparatus of one group. They shall contain the single components or apparatus of one group arranged in the correct physical location including terminals and terminal boards. The connections shall either be represented by lines or, in case of a "wireless" connection diagram, by a wire table.

The external connection or interconnection diagram shall show the external wiring or tubing connections between the different units of an installation.

13. Terminal Diagrams

a. Such diagrams shall be prepared for any type of terminal box, marshalling rack, control cubicle, switchboard, etc., and shall show the terminals (properly numbered) and the internal and/or external conductors (wires or cables) connected tothem.

b. The terminal diagram of each individual switchboard, terminal box, panel, etc., shall contain, but not be limited to the following information:

- Terminal number of terminal board with targets (terminal number and current path) of incoming and outgoing cables and wires
- Cable designations
- Type of cable
- Number and cross-section of conductors
- Assignment of conductors
- Number of spare conductors

- Approx. length of cable and its destination

14. Protection Coordination Diagrams

These diagrams shall show in a graphical manner separately for each power supply circuit:

- A simplified single-line diagram of the circuit with technical data of all instrument transformers and relays
- Coordinated tripping curves of related protection devices
- Setting of the protection devices.

15. Control and Instrument Switch Position Tabulation Diagrams

Switch position tabulation diagrams of control and instrument switches shall show terminal arrangement, escutcheon plate and contact tabulation. On each schematic diagram where switch contracts are shown, switch position tabulations for the indicated switches shall be included somewhere on the same drawing.

16. Nameplate Schedule Diagrams

A nameplate schedule diagram shall show designations on all nameplates. The wording of each nameplate designation may be revised to satisfy physical limitations subject to the approval of the Project Manager.

17. Schedule Diagrams of "Fault Annunciators" and "State Indicators"

a. A schedule diagram shall show all designations of the fault annunciators and the state indicators including spares provided. The wording of each window may be revised by the Project Manager to facilitate the operator's job.

b. For the annunciator, the Contractor shall furnish enough information in detail to understand complete operation of the annunciator. If the annunciator is to be of the static type, it shall be furnished with a description of the operation of each component and an explanation of the operation sequence of each component in regards to the overall annunciator scheme.

18. Bill of Components

Bill of components shall include manufacturer's name, model number and all guaranteed technical characteristics of each offered item. The list shall, furthermore, include any and all technical characteristics referred to in these specifications and shall state to which standards the equipment will conform.

1.3.5 Specifications and Calculation Sheet

1. Specification of Packing

   The Contractor shall submit the specification of packing indicating the sizes, weight, packing materials/methods, outline sketches, transportation way (ship/air mail), comments for storage way, etc.

2. Equivalent Standards

   If the Contractor prefers to use the Equivalent Standards not mentioned in the General Requirement of the Technical Specification, the Contractor shall submit the authorized English version or the original standard's copy with English translation/comments showing the correspondence with the specified standards. If the Contractor cannot submit the English version or the equivalent, the Contractor shall use the specified standards mentioned in the General Requirement of the Technical Specification.

3. Load Diagrams and Calculations

   Immediately on completion of design, the Contractor shall submit to the Project Manager for approval the listed total static and dynamic loads acting on the equipment together with the design calculations. The Project Manager reserves the right to require the detailed calculation of any equipment prior to approval of the relevant drawings.

4. Other Calculations

   The Contractor shall submit the specified calculations in the Technical Specification and shall include in the key drawing list. The Project Manager reserves the right to require the additional calculations of any equipment even if it is not mention in the list and the Technical Specification.

1.3.6 Lists and Schedules

1. Time Schedule

   The Contractor shall submit the Time Schedule covering the design, manufacture, delivery, erection, testing and commissioning of the Works.

2. Quality Assurance Programme

   If the manufacturer has been assessed and approved by the authorized quality assurance party that ISO 9001 quality management system is applicable to design, manufacture and installation of the Electromechanical Equipment, the manufacturer shall be requested to supply a brief explanation of the whole quality assurance (QA) programme to be followed during manufacture and testing of the equipment. If the manufacturer doesn't have/supply the certificate of approval of ISO 9001, he shall submit details of the quality assurance programme in accordance with standards of ISO 9000 series other standards.

3. Cable Schedule

   The Cable Schedule shall include for each individual cable the following as a minimum:

   - Cable number
   - Cable type
   - Rated voltage
   - Number and size of conductors
   - Overall diameter
   - Cable termination at each end
   - Connection point at each end with cubicle/equipment identification and terminal numbers
   - Location of cable in rack
   - Cable length
   - Drum number
   - Quantity and specification of cable rack, cable duct and conduits
   - Fire-proofing measures

4. Transportation Schedule

The Contractor shall provide the transportation schedule for the large/heavy Equipment and all other miscellaneous packing. For the large/heavy Equipment, the details shall be provided including the routes, periods, ports facilities, trailers, cranes, temporary works to be required for the reinforcement along the route, environmental precaution, permission from the local government office, etc. Size and weight of equipment/ components shall be devised as per transportation limitations of site.

Cable termination kits an all the components having low shelf life shall be supplied near the period of COD and if it gets damaged/ expired due to delay or any other reason, then it must be provided by the contractor.

5. Plan for Shop-Tests

The Plan for Shop Test shall include the following items, such as name of object equipment for test, location of test, date (year, month, day) of test, applied standard, testing procedure and drawing (recorded with testing circuit, etc.), testing facilities and measuring instruments, the drawing number and title of the object equipment, attendance of the Purchaser and Consultant's Personnel, and recording papers (with contents of testing records) etc. The recording papers shall include the following descriptions, such as name of object equipment, date (year, month, day), temperature, humidity, specification, testing and measuring items, testing criteria, signature of testing personnel and the witness of test, etc. The in house test report of shop test, which is to be attended by the Purchaser and Consultant's Personnel, shall be prepared completely furnishing all shop test items and shall ensure all results conforming the specification.

6. Plan for Field-Test

The Contractor shall submit a plan for all items of field tests and shall include the following descriptions, such as testing items, procedure and adjustment of test, drawings for testing circuit or testing scope, testing facilities and measuring instruments, and the form of the recording papers. The recording papers shall be described with the following contents, such as testing items, unit numbers, date (year, month, day), temperature, humidity, testing and measuring facilities, the records of water level, testing criteria, signatures of testing personnel and the witness, etc.

7. Monthly Progress Report

The Contractor shall furnish monthly progress reports to the Purchaser/Project Manager. The reports shall be in the form as approved by the Project Manager and shall contain the following information:

- Physical progress reports for the preceding month and estimated progress for the current month. Where the progress falls behind the agreed detailed time schedule, the report shall include details of the measures proposed to ensure completion of the Work on time.

- Completion schedule (targets and actual) based on the agreed detailed time schedule, as provided under Schedules ofVolume IV.

- Estimates of monthly payments for permanent Works, for the following six (6) months, indicating the amount to be paid in foreign currency and/or inRupee.

- The status of all Contractors' drawings required to complete the Works.

- A progress statement showing the amount of all work completed at the Contractor's and/or Subcontractor's workshop and/or shipped from the port of shipment during the month covered by the report and cumulatively to the end of that month.

- Percentage of shipped Equipment and of delivered Ex-factory and Ex-stock Equipment.

- Percentage of installed Equipment.

- One print of 15cm x 10cm size of at least 24 colour photographs showing the progress of the Works. All prints shall be designated by the taking date and by an identification number, both automatically processed when taking the photographs.

  Set of prints shall be, accompanied by a schedule of the identification numbers, taking dates, titles or descriptions of the location and view where the photographs have been taken, which shall be supported by maps, plans or suitable drawings, whenever required.

All negatives shall be numbered and kept on Site on completion of the Works the negatives shall be handed over to the Project Manager.

8. Monthly Erection Schedule

The monthly erection schedule shall be prepared in the form of Critical Path Method Network or an approved method, covering the detailed erection time schedule of the Equipment and related other contractor's works. Before submitting the schedule to the Project Manager, the Contractor shall coordinate the erection works with the related civil works contractor or other contractor. This schedule can be provided within the "Monthly Progress Report" and which shall bring out the delay in the previous month, if any, as also the required/planned.

9. Erection Staff List

The erection staff list shall include all personnel, from the superintendent to the temporary worker, name, age, position, roles, residence place and period, emergency number, skill, qualification, etc. For the key personnel, such as superintendent, safety control officer, chief/erection/testing Project Manager and operation instructor, his personal history shall be submitted to the Project Manager.

For the special technical skill workers, such as welders, crane operators, X-ray non-destructive inspectors, etc., his certificate copy shall be submitted to the Project Manager. This list can be provided within the "Monthly Progress Report".

10. Temporary Work Program

The temporary work program shall include the camp layout, site office layout, electricity demand program such as maximum power demand and energy demand of each month, outline of electric facilities used during erection works, plan of power cubicles, distribution cubicles and distribution lines, supervising methods of power supply, plan of telephone and communication system, plan of water supply and sanitary system, storage area, disposal area, outdoor lighting, fences, watching post etc.

11. Safety and Sanitation Program

The Contractor shall provide his safety and sanitation program. This program shall include plan of safety facilities, safety criteria and measures, action program to enhance the awareness of safety, communication routes at emergency, etc. The Project Manager will hold a safety and sanitation conference under the safety and sanitation management organization once a month inviting all major contractors. The Contractor shall submit the monthly program to the conference and shall coordinate with the members about the program. The monthly program can be provided within the "Monthly Progress Report".

12. Accident Report

a. The Contractor shall report in writing within twenty-four (24) hours from their occurrence, to the Project Manager, the local police and the local labour inspector, all accidents occurring on any of the Works or in connection therewith.

b. In the event of serious or fatal accidents, the Contractor shall leave unchanged the conditions existing at the Site and at the time of the accident so that the authorities may proceed with their investigations to ascertain the causes of the accident. Also, more specific accident report shall be submitted to the Project Manager including the analysis of the cause, situation of the injured personnel, future pre-caution methods, additional safety facilities, etc.

13. Erection Record

a. The Contractor shall provide the erection records including the actual erection process and time schedule, record of welding, record of actual dimensions and clearances, deformation before and after concrete work, centering and leveling results, non- destructive test results, adjustment results, supporting facilities layout, use of special tools, concrete and grouting records, details of temporary work,etc.

b. The Contractor shall record all initial dimensions and set values to be required at the future disassembling and assembling work.

c. The erection record sheets shall commonly contain the contents for recording unit No., date, temperature, weather, inspector's signature, etc.

d. The Contractor can provide the erection record sheets in the "Instruction Manuals and Drawings for Erection" and complete the "Erection Record" based on the Instruction Manuals.

1.3.7 Manuals

1. Instruction Manuals and Drawings for Erection

a. The Contractor shall submit instruction six (6) copies of manuals with Material Despatch Clearance Certificate (MDCC) including pertaining drawings for all Electromechanical Equipment to be supplied and erected. The manuals shall be written in English.

b. The manuals shall give details and data in sequence as required for the guidance of the Contractor's erection team as to all procedures and precautions to be observed when erecting, welding, assembling and adjusting the Electromechanical Equipment, and shall embody in particular a full statement as to tolerances to beobserved.

c. The instruction manuals shall include all the instructions for the correct storage of the Electromechanical Equipment at Site.

d. Furthermore, the Contractor shall submit detailed directions as to the methods and procedures to be followed and the dimensions to be observed and recorded in checking the accuracy of erection, and the carrying-out of Field tests as required by the Technical specifications. It shall also include a schedule of the tests and a description of all instruments provided for these tests and of their use.

e. Should a revision of the instruction manuals and drawings become necessary as a result of information gained during erection, the Contractor shall immediately effect the revision and forward to the Project Manager additional copies of the revised instruction manuals and drawings.

2. Operation and Maintenance Manual

a. Scope

i. The Contractor shall provide six (6) copies of combined operation andmaintenance manuals in English version of equipment specified in Chapter – 2 to 22 the scope

of which shall be suitable for fully informing the Purchaser's staff on all aspects of the operation and maintenance of the Electromechanical Equipment, as further defined in this Clause. The manuals shall be drafted in combined two volumes i.e. i.e. one is exclusively states Operation methodology and second one exclusively of Maintenance and its detailed procedure and final forms and the final payment for supply shall subject to submission of final forms of combined operation and maintenance manuals. Both manuals shall be hard cover bond.

ii. The content of the manuals shall be directly applicable to the Electromechanical Equipment. Typical manuals will not be accepted. Standard manuals covering a number of sizes and/or models of proprietary equipment will be accepted provided they cover the items supplied and these items are clearly identified throughout the manuals.

iii. The manual shall give specific information as to oil, grease, or any other materials needed for maintenance operation. This information shall include brand names and manufacturer's members or designations preferably available in India.

iv. The manuals shall give detailed instructions and procedure relating to operation and maintenance of the Electro-mechanical equipment.

v. The manuals shall be subdivided on an equipment chapter by equipment basis, with the content for any one equipment self-contained, complete and separate in all respects from the content for other equipment.

vi. The content for each equipment of the manuals shall comprise the following separate sections:

Section 1	Contents
Section 2	Introduction
Section 3	Description
Section 4	Operation
Section 5	Maintenance
Section 6	Separately Bound Drawings
Section 7	Brochures for Proprietary Equipment

This subdivision and the section reference numbers shall be adhered to except that brochures covering more than one section will be accepted for minor components

of proprietary equipment. The detailed content for each section shall be as defined in Clause.

b. Format and compilation - content of final manuals

i. The text, diagrams, drawings, brochures and all other content shall be reproduced in ink by letterpress or offset printing or in carbon by electrostatic printing. Reproductions obtained by using dyes, chemicals or photo-sensitive or heat-sensitive materials are not acceptable.

ii. All text shall be on size A4 paper except that brochures of smaller sizes will be accepted for minor components of proprietary equipment provided they have adequate binding margins.

iii. Diagrams and drawings provided as part of the manuals shall be size A3 wherever the original is size A3 or larger and size A4 for allothers.

iv. Drawings bound into the text shall have a size A4 margin on the left hand so that they may be unfolded and viewed in full while reading the associatedtext.

v. Text, drawings, diagrams and illustrations included in the manuals shall be easily readable by a person having normal eye sight.

vi. The Contractor will arrange for the compilation of the instruction material into volumes including the provision of binders and punching, trimming and collating the material provided by the Contractor.

vii. The Contractor shall deliver his manuals with the content for each equipment separately packaged and each copy for any one equipment clearly separated.

c. Format - draft manuals content

The format of the draft manuals may differ from the requirements of Clause 1.3.7 (2) (b) subject to the following:

i) The Contractor shall deliver his manuals with the content for each equipment separately packaged and each copy for anyone equipment clearly separated.

ii) Text, drawings, diagrams and illustrations included in the manuals shall be easily readable by a person having normal eyesight.

iii) Instructions and procedure to be followed during O&M of electromechanical equipment shall be self explained.

d. Program for delivery of manuals

The Contractor shall deliver the required number of copies of the complete draft and complete final manuals within the periods nominated inSection-6, para "Drawing and Data Schedule" of Volume I.

e. Detailed content

i. General

The requirements for content set out in this Clause apply to the draft and final content unless specifically stated otherwise.

The content for each plant feature, as defined in Clause 1.3.7 (2) (a). shall include all the material required by this sub-clause.

ii. Section 1 – Contents Section

The feature name and list of sections shall be as in Clause 1.3.7 (2) (a).

iii. Section 2 - Introduction

- Subsection 2.1 - Purpose and Nature

Brief description of the basic purpose of the equipment without quantitative performance data but including reference to any other, major, closely associated equipment, e.g. turbine section will refer to generator. Also a brief definition of type of equipment with main performance characteristics such as rating, head, speed, voltage etc.

- Subsection 2.2 -History

Brief statement of the organizations involved in the design, manufacturer, and erection of the Electromechanical Equipment including main subcontractors and space for data when the equipment entered commercial service, to be entered later by the Project Manager.

iv. Section 3 -Description

- Subsection 3.1 - Bound-in Drawings and Data

- Index of drawings contained in Section 6 of the manuals.
- All performance data over the full range of operating condition, both normal and abnormal.
- Setting data for all quantities, both permanent and adjustable.

- Subsection 3.2 -Description

A comprehensive description defining the generic type of equipment and component, method of construction, materials of main components, design features, control and protection functions, relationship with other equipment and including the description of auxiliaries specific to the equipment (for example governor for the turbine) but not auxiliaries of more general application (e.g. unit cooling water system).

- Subsection 3.3 -Reference

A list of all other equipment which are directly associated with the operation and/or maintenance of the equipment concerned.

v. Section 4 -Operation

- Subsection 4.1 – Operating Sequences

Brief description of the operational functions of which the equipment is capable and a reference to the manuals volumes covering operation in detail.

- Subsection 4.2 – Operating Limits

  Tabulated data of limits for all operating parameters and reason for limit.

- Subsection 4.3 - Pre-start Check List

  Comprehensive tabulated list or sequence diagram of all conditions which must be checked before the Electromechanical Equipment may be started after being out of service.

- Subsection 4.4 - In-service Check List

  Comprehensive tabulated list of all observations to be made during periodic inspections and tests, defining the location, range of acceptable values and action to be taken if incorrect values are found.

- Subsection 4.5 – Abnormal Conditions

  Comprehensive tabulated list of all abnormal conditions which can arise due to a malfunction in the Electromechanical Equipment, how the malfunction becomes apparent, and the action to be taken including any diagnosis to establish details of the nature of the malfunction.

vi. Section 5 -Maintenance

- Periodic service and maintenance procedures including maintenance schedules defining:
  - Component and condition to be checked and procedure of checking.
  - Required frequency of checking
  - Equipment and stock required
  - Required plant condition for service or maintenance includingrequired isolation
  - Dismantling sequence and methods
  - Inspection of components, detailed checks for condition and criteria for acceptance, rejection or reconditioning
  - Reconditioning, replacement and adjustment procedures
  - Re-assembly sequence and methods

- Fault diagnosis based on symptoms of malfunction and wear.

- Recommissioning procedures after major overhaul.

- Lubrication requirements.

vii. Section 6 - Separately Bound Drawings

One copy of each drawing referred to in the text or necessary for clear understanding and use of the text, including all assembly, layout and arrangement drawings. The drawings shall be preceded by a list with titles and numbers, in numerical order.

viii. Section 7 - Brochures for Proprietary Equipment

Manufacturers' brochures, instruction pamphlets and the like, containing the operation and maintenance information as specified in paragraphs (e) above, in respect of proprietary equipment.

1.4 Delivery, Installation and Commissioning:

1.4.1 Packaging, handling and site storage:

The Contractor shall follow the general requirement of Packaging, Handling and Storage .

The Contractor shall pack all the consignment in sea worthy packaging, wherever required, strong enough to withstand rough handling during transit. Machine surface shall be suitably protected against scratches, corrosion, shocks, impact etc. Packages shall be suitably and distinctly identified for type of handling and kind of storage.

The packaging and storage of electronic equipment shall be strictly in accordance with internationally accepted standards. Electronic equipment shall be packaged, shipped and stored in anti-static packing. All packages shall be stored indoor. Packages containing electronic equipment shall be stored in humidity controlled environment.

1.4.2 Installation:

The Contractor shall follow the requirements of installation.

The Contractor has to do all the work related to assembly, erection, testing and commissioning complete in all respects. All necessary tools, plants, labour

materials including consumables for performing installation, testing and pre-commissioning shall be provided by the Contractor.

The Contractor shall submit the necessary data/information, layout and foundation/support drawings well in advance.

The Contractor shall provide and install the concrete inserts/embedment; support steels and/or components for foundation/supports purpose as per approved erection drawings and coordinate the activities with civil contractors to keep his activities in synchronism with civil work. All installation for foundation shall be verified and accepted by the Employer. However, any civil works specially mentioned in technical specification and in the scope of E&M contractor, shall be carried out by the E&M contractor.

The Contractor shall use anchor fasteners for installation of piping, fixtures, mountings, conduits, cabling, panels etc. Chipping of concrete and/or taking support from reinforcement bars shall not be allowed.

The design, location and approval tests of anchoring rings for the fixing of lifting apparatus necessary for assembly and dismantling of equipment and plant accessories shall be the responsibility of the Contractor.

The Contractor shall supply sufficient number of erection and commissioning spares based on their experience so that erection, testing and commissioning work progresses smoothly and is not hampered for want of such spares. These spares shall be in addition to the spare parts described under clause "Spare Parts".

1.4.3 Installation procedure:

The Contractor shall submit six copies of all detailed programs and the procedures to be adopted for erection / installation, testing and commissioning well in advance, before start of erection activities/ installation, for approval of the Employer.

The installation procedure shall also have a section "site quality assurance plan" containing erection data sheets for various components. These sheets should specify site measurements / inspections required to be made for ensuring proper installation.

1.4.4 Field welding

The Contractor shall select the proper filler material with respect to parent material for all field welded connections and shall specify it on the applicable drawing, together with the detail design of the field weld joint.

All cutting, chamfering, and other shaping of metals necessary for the field connection shall be done as far as possible in the shop. Adequate temporary

bolted field connections shall be provided to hold the assemblies rigidly and in proper alignment during shop and field assembly.

1.4.5 Cable laying:

Wiring between equipment enclosures shall be made with cables, laid in trenches and/or cable trays and in cable conduits. The Contractor shall submit for review to the Employer a cable route layout-showing location of trenches, conduits and trays. All material for cable laying such as cable trays supports and fastening material shall be furnished and placed by the Contractor. Cables shall be properly fastened and marked where they enter enclosures by either cable clamps or nipples.

Cables in horizontal cable trays shall be fastened properly with clamps or plastic strips. Power and control cables shall be placed in separate trays or conduits. Cables shall be clearly marked at each terminal point.

1.4.6 Embedded parts and anchor bolts:

All embedded anchor bolts, rods, welding plates and support plates shall be provided. Anchor bolts shall consist of a threaded steel rod installed inside a pipe sleeve to provide lateral adjustment after the sleeve is embedded. The embedded end of the rod shall be provided with a steel plate, which shall be welded to the rod and sleeve to provide anchorage and to prevent entry of concrete into the sleeve during installation.

The threaded end of the rod shall be provided with two steel nuts and two steel washers to permit levelling and anchoring the equipment prior to grouting.

Approved types of expansion or chemical anchors shall be used where practicable for small equipment.

1.4.7 Installation records

The Contractor shall maintain the installation records including installation quality control (QC) records of each activity to ensure quality of installation as per specification/requirement. The QC record shall clearly show the achieved erection tolerances vis-à-vis the allowable limits. The installation records shall be submitted to Employer for approval/ acceptance to establish completion of installation milestones as per program of performance. All installation records shall be compiled and submitted to the Employer before taking over the respective unit. Completion certificate for any work shall be issued only after approval / acceptance of complete installation records.

1.4.8 Field inspection

The Contractor shall permit Employer to perform inspections of the assembly which will include a complete verification of the assembly of all parts as to their levels, clearances, pertinent fits, alignments and quality of workmanship. The

field supervisor of the Contractor shall provide Employer with three (3) copies of all the clearances, tolerances and data of all pertinent fits, alignments and levels, so that the latter may repeat the Contractor's measurement, if desired. Unless otherwise specified, any rejection based on the inspection will be reported to Contractor within fifteen (15) days and injurious defects subsequent to assembly and acceptance will be rejected.

1.5 Transportation limitations:

For shipments, the Manufacturer shall pack the items to meet size and weight restrictions of the Indian railways and road systems upto project site.

Shipments from Manufacturer's work (in case offshore consignments) shall travel to Port of entry – India, from where these will be transported, after necessary port clearances etc., by the Contractor to nearest rail head for the Project, and further transported to site. However, in certain cases the Contractor may be required to transport the materials from Port of entry to Project site directly by road transport. For onshore consignments, the Contractor shall be responsible in all respects for transportation of all material and equipment up to the projectsite.

The Contractor shall consult with the concerned authorities in railways and highways to ensure that his packaging will be such as to permit him to transport the plant and equipment within such imposed limits. The Contractor shall arrange to deliver the maximum sized sub-assemblies consistent- with safe and convenient transport.

All materials and equipment etc. arrived at nearest railhead for the Project will be unloaded from rail wagons and reloaded on to road transport for shipment to project site by the Contractor.

All components shall be so designed and constructed as would enable easy assembly of components at works and at the same time permit easy transportation. The weights and sizes of the components/packages shall be designed in such a way that they should not overshoot the permissible carriage limit of roads as well as the ropeways for project site.

1.6 Report on petrographic analysis

Report on petrographic analysis of suspended sediment samples of HP. Power Corporation Limited, Ravi & Chenab projects, Himachal Pradesh

Petrology
Division
Geological
Survey of
India S.U:
Haryana
Faridabad

SEPTEMBER 2014

Report on petrographic analysis of suspended sediment samples of HP. Power Corporation Limited, Ravi & Chenab projects, Himachal Pradesh

INTRODUCTION

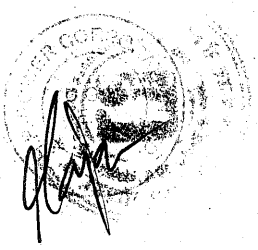
This report embodies petrographic study of two silt samples from HPPCL, Ravi & Chenab Projects, H.P. These samples were collected by the sender and received, vide letter no. HPPCL/DGM/SSHEP/G-14/2014-271-72 dated 8.7.2014. Petrographic charges of Rs.9527/- were received on 08.9.2014.

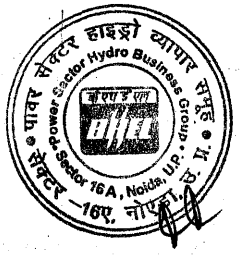
The samples were subjected to sieve analysis, preparation of grain mounts, petrographic study and photomicrography. Data of Sieve analysis has been statistically represented along with relevant graphical output. A total number of four grain mounts were prepared from two samples for petrographic studies and photomicrography. The entire work was carried out at Petrology Laboratory, GSI, Faridabad.

The petrographic observations given here under solely pertain to the sample supplied by the sender and the extent of generalization to the field area may be ascertained by the collector of the samples.

The rocks have been classified as per Indian standard "SPECIFICATIONS FOR COARSE AND FINE AGGREGATES FROM NATURAL SOURCES FOR CONCRETE" (Second revision) IS: 383-1970 (Reaffirmed 1997).

It is suggested that for better understanding silt samples of sediments laden waters entering turbines may be collected periodically during pre-monsoon, monsoon and post-monsoon period and studied petrographically





BACKGROUND INFORMATION

The petrographic studies of suspended sediments are aimed at determining the strength of the blades to be used in the turbines through which the sediments laden river waters have to pass through. In this context, the mineralogical constituents are identified and modal percentages are determined vis-à-vis their hardness.

As per the requirements of petrographic studies of suspended sediments for hydroelectric projects, the petrographic analysis has been undertaken for the sample in terms of grain size analysis and mineral identification of the suspended sediments based upon their optical properties.

GRAIN SIZE ANALYSIS TECHNIQUE

Standard sieve analysis of the samples was carried out by means of motorized sieve shaker (AIIMIL) with sieve sets of, +75, +38 and -38 micron size. The grain size mentioned of sediments is as per Wentworth Udden scale. The standard notation method has been used in recording the data (i.e. +75 fraction represents size of the grains size between -125 and +75 micron and so on).

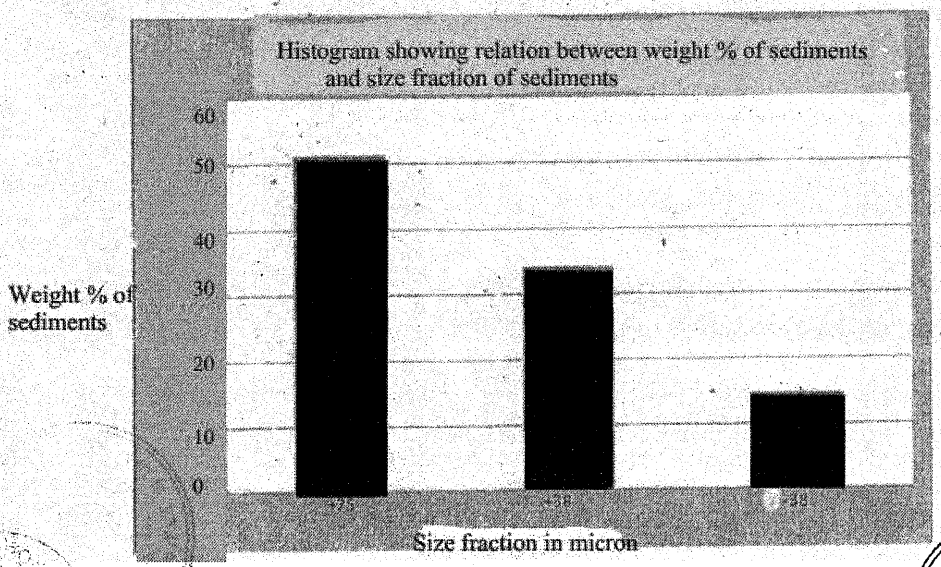
2. SAMPLE NO. HEP-48MW
LOCATION: Intake site of Chanju III HEP (48 MW)

Grain Size Analysis

The sieve analysis of the sample is given in Table 1 of Datasheet-II. It is evident from the table that in the sediments recovered from suspended material at above location, the fraction i.e. +75μ, which includes very fine sand has maximum (51.29 %) of the suspended sediment followed by +38 μ, which includes very fine sand and coarse silt having 34.16 % of the suspended sediments. The finest fraction i.e. -38 μ have 14.55 % of the suspended sediments. The given sediment sample is of very fine sand and coarse silt fraction.

Mineral Identification and Modal Percentage

From the grain analysis it is very clear that +38 μ size fraction and +75 μ size fractions comprise the maximum percentage of suspended sediments followed by -38 μ size fractions. Since fractions in -38 μ size are very fine to be studied under microscope, +75 μ size and +38 μ size fractions have been selected for mineral identification and evaluation of the modal content. The mineralogical content of the samples are quartz (H=7), micas (H=2.5-4), feldspar (H=6-6.5) and magnetite (H=5.5-6.5). Table 2 of Datasheet - IIrepresents the different minerals identified, their hardness (H, as per Moh's scale) and modal percentage.



Petrographic Analysis

Megascopic Study:

The given fine aggregate sediment sample is dark grey in colour with shining tinge. The fine aggregate consists of very fine sand and silt with a few pebbles. The minerals identified in hand specimen include quartz, mica and ferromagnesian minerals. It is well sorted silt sample and the pebbles are sub angular in shape.

Microscopic Study:

Under the microscope, the +75 μ size sand fraction comprises angular to sub-angular fragments of quartz, feldspar, mica and magnetite. Quartz occurs as sub-angular to sub rounded grains. Feldspar grains are partially to fully altered and a few grains of plagioclase feldspar show characteristics twinning. Mica flakes include muscovite. Magnetite occurs as subhedral opaque grain. Some of the grains are coated with iron oxide. Some of the quartz grains show strain lamellae. Due to unnatural orientation of the quartz grains undulose extinction angle cannot be determined correctly (Fig. 1).

The size fraction +38 μ consist mainly of quartz, feldspar, muscovite, and magnetite. The quartz grains are mostly sub angular to sub rounded in shape. The feldspars are mostly untwinned with some grains are partially to fully altered. Mica flakes include muscovite. A few mica flakes are altered. Magnetite occurs as opaque mineral. Some of the grains show coating of iron oxide. Due to unnatural orientation of the quartz grains undulose extinction angle cannot be determined correctly (Fig. 2).

Remarks

The sample mainly consists of quartz, feldspar, mica and magnetite.

DATA SHEET-II

2.SAMPLE NO. HEP-48MW
LOCATION: Intake site of Chanju III HEP (48 MW)
Project: H.P.POWER CORPORATION LTD, RAVI & CHENAB PROJECTS, HIMACHAL PRADESH

Table No. 1: Grain size analysis of suspended sediments.

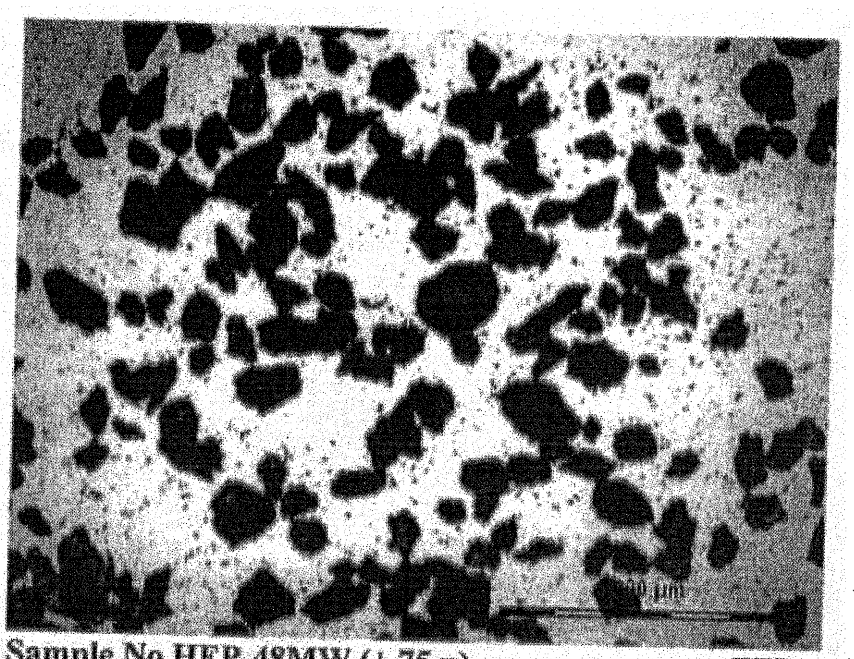
Sl.No.	Size Fraction		Wt. %	Cumulative Wt. %
1	+75	Very fine sand	51.29	51.29
2	+38	Very fine sand + coarse silt	34.16	85.45
3	-38	Medium and fine silt	14.55	100

Table No. 2: Mineralogical composition (in %) of sediments of suspended material

Sample No.	Grain Size (μ)	Quartz (H*=7) (Sp**= 2.65)	Feldspar, (H*=6-6.5) (Sp**2.57-2.76)	Mica (H*=2.5-4) (Sp** 2.7-3.0)	Magnetite (H*=5.5-6.5) (Sp** 5.17-5.18)
1	+125	70-71	13-14	5-6	10-11
2	+75	69-71	15-16	4-5	9-11

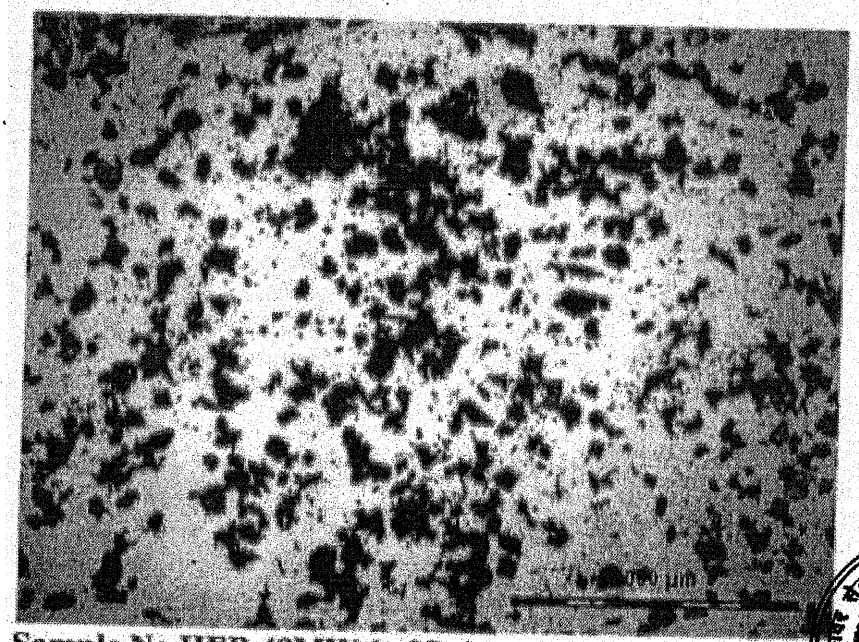
Abbreviations used:
H*: Hardness & Sp** Specific gravity: **given values are standard for the minerals, and not the measured ones.**

000101



Sample No.HEP-48MW (+ 75 μ) PPL

Fig. 1: Sub- angular to sub rounded grains in the sample



Sample No.HEP-48MW (+ 38 μ) PP

Fig. 2 : Sub- angular to sub rounded grains in the sample

The silt data of previous years is enclosed.

1.7 Salient Features

1.1	**LOCATION:**		
	State	Himachal Pradesh	
	District	Chamba	
	River/Nallah	Chanju Nallah/Mahed Nallah is a tributary of Baira River	
	Vicinity	Diversion Weir on Chanju nallah at El. 2100 m near village Dantoi, Diversion weir on Mahed nallah at El. 2093.00 and power house on the left bank of Chanju nallah at EL. + 1616.50 m near village Jakhla just upstream of confluence of Chanju and Mahed nallah	
	S.O.I. Sheet No	52 D/6, 1:50,000 52 D/6 NW/NE, 1:15,000	
	Co-ordinates	Longitude	Latitude
	Weir Site - Chanju nallah	76°20'07"	32°42'15"
	Power house site	76°16'35"	32°42'59"
1.2	**HYDROLOGY**		
	Catchment area at Chanju nallah diversion weir site	95.50 Sq Km	
	Catchment area under permanent Snow at Chanju diversion weir site	19.25 Sq Km	
	Total catchment area at Chanju Nallah diversion weir site	114.75 Sq. Km	
	Catchment area at Mahed nallah diversion site	30.50 Sq Km	
	Design Flood Chanju nallah Mahed nallah	 385 cumecs 165 cumecs	
	Design discharge Chanju nallah Mahed nallah	 9.13 cumecs 2.43 cumecs	

1.3	**PROJECT STRUCTURES**	
1.3.1	**TRENCH WEIR (ON CHANJU NALLAH**	
	Type	Drop type trench weir 30 m (L) x 2.00 m (W)
	Top Elevation	2100 m
	Diversion design discharge	14.46 cumecs
	Shingle flushing discharge	2.41 cumecs
1.3.5	**TRENCH WEIR (ON MAHED NALLAH)**	
	Type	Drop type trench weir 15 m (L) x 1.20 m (W)
	Top Elevation	2093.05 m
	Diversion design discharge	4.04 cumecs
	Shingle flushing discharge	0.68 cumecs
1.3.2	**FEEDER TUNNEL (ON CHANJU NALLAH)**	
	Length	43.00 m
	Size	2.1m X 2.4m
	Slope	1:550
	Velocity	2.56 m/s
1.3.6	**FEEDER TUNNEL (ON MAHED NALLAH)**	
	Length	33.00 m
	Size	1.80m X2.10m
	Slope	1:350
	Velocity	2.34 m/s
1.3.3	**DESILTING CHAMBER (ON CHANJU NALLAH)**	
	Type	Two no. Conventional continuous hopper type Underground Desilting tank.
	Size	90 m (L) x 5 m (W) x 9 m (H)

	Particle size	Designed to exclude all silt particles down to 0.20 mm size.
	Silt Flushing discharge	2.10 cumecs
13.5 (a)	**Silt Flushing Tunnel**	
	Type & Size	2.1 m D-shaped
	Velocity	3.12 m/sec
	Length	58 m
1.3.5 (b)	**Construction Adit cum inspector tunnel**	
	Type & Size	2.40 m D-shaped
	Length	45 m
	Velocity	
1.3.5 (c)	Gate Chamber Size	5x5 m
1.3.7	**DESILTING Chamber ON MAHED NALLAH**	
	Type	One no. Conventional continuous hopper type Underground Desilting tank.
	Size	40 m (L) x 3 m (W) x 6 m (H)
	Particle size	Designed to exclude all silt particles down to 0.20 mm size.
	Silt Flushing discharge	0.65 cumecs
1.3.7 (a)	**Silt Flushing Tunnel**	
	Type & Size	2.1 m D-shaped
	Velocity	2.54 m/sec
	Length	45 m
1.3.4	**HEAD RACE TUNNEL FROM CHANJU NALLAH**	
B)	**Adits**	

(i)	Adit –I (RD 790.98m)	
	Type & Size	2.70 m X 3.0 m D-shaped
	Length Portal invert elevation	+ 54 m 2091.10
(ii)	Adit –II (RD 1393.73m)	
	Type & Size	2.70 m X 3.0 m D-shaped
	Length Portal invert elevation	+ 55m 2089.94 m
(iii)	Adit –III (RD 2028.03m)	
	Type & Size	2.70 m X 3.0 m D-shaped
	Length Portal invert elevation	+ 54 m 2088.90 m
(iv)	Adit –IV (RD 3091.91m)	
	Type & Size	2.70 m X 3.0 m D-shaped
	Length Portal invert elevation	+ 58 m 2086.65 m
(v)	Adit –V (RD 4163.69 m)	
	Type & Size	2.70 m X 3.0 m D-shaped
	Length Portal invert elevation	+ 53 m 2085.04 m
A)	**HEAD RACE TUNNEL**	
	Type & Size	Concrete lined HRT 2.70 m X 3.0 m D-shaped
	Length	5090 m
	Slope	1 in 550
	Design discharge	10.04 cumecs
	Velocity	2.70 m/sec
1.3.8	**CONNECTING TUNNEL FROM MAHED NALLAH**	
	Type & Size	Concrete lined HRT 2.10 m x 2.40 m D-shaped

	Length	1190 m
	Slope	1 in 340
	Design discharge	2.80 cumecs
	Velocity	2.70 m/sec
1.3.9	**Adit –VI to Forebay construction Adit No. VI to top horizontal Reach of Pressure Shaft**	
	Type & Size	2.70 m X 3.0 m D-shaped
	Length	+ 63 m
1.3.10	**UNDERGROUND FOREBAY**	
	Type	Under ground
	Size	160 m (L) x 5 m (W) x 5 m (H)
	FSL	2092.20 m
	MDDL	2089.20 m
	Storage capacity	4000 cum
	Peaking time	± 3 minutes
1.3.11	**BUTTERFLY VALVE CHAMBER**	
	Length	10.50 m
	Width	6 m
	Height	12 M
	Butterfly Valve Dia	1.90 m
1.3.12	**PRESSURE SHAFT**	
	Type	Under Ground
	C/L Pressure Shaft at forebay	2083.9m
1.3.12 (a)	**Dimensions of Pressure Shaft**	
	Internal Dia. of main Penstock	1900mm (steel liner)
	Internal Dia. of branch Penstock	1100mm (steel liner)
	Internal Dia. Between Wye-I & Wye-II	1350 mm(steel liner)
	Length	As per drawings enclosed in Bid document Vol-V
1.3.12 (b)	**Intermediate Adit to Pressure Shaft**	
	Type & Size	3.5m x 3.5 m m D-shaped
	Length	238.06 m
1.3.13	**UNDERGORUND POWER HOUSE**	
	Type	Under Ground
	Size	61.50 m x 13 m x29.10m
	C/L of jet	1618 m
	Generating Units	Vertical Shaft, Pelton wheel

		driven, three units of 16 MW each
	Installed Capacity	48 MW (3 x 16 MW)
	Max. Gross Head	474.20 m
	Net Head	466.82m
1.3.13 (a)	**Main Access Tunnel**	
	Type and Size	7.00x7.00m D-Shaped
	Length	191.89 m
	Slope	1:300
1.3.13(b)	**Cable-cum-Ventilation Tunnel**	
	Type and Size	5.5m D-Shaped
	Length	91.04m
	Slope	1:200
1.3.14	**TAIL RACE TUNNEL**	
	Type & Size	3.0 mx 3.0 m, D- Shaped
	Length	117.26 m
1.3.14 (a)	**Branch Tail Race Tunnel**	
	Type and Size	2.20m x 2.20 m, D- Shaped
	TRT1	
	Length	32.47m
	Slope	1:850
	TRT2	
	Length	25.894m
	Slope	1:700
	TRT3	
	Length	32.289m
	Slope	1:700

1.8 Quality Assurance Plan

The general requirements of various quality checks at raw material stage, in process stage, final testing stage have been prepared equipment wise for the necessary consideration of bidder (Annexure attached). These checklists of quality assurance plan have been prepared in coherence with various standards and accordingly various tests need to be performed as mentioned in individual chapters of Volume III as well as in Quality Assurance Plans (QAPs). However, the successful bidder shall provide the equipment wise quality assurance plan in line with above but not limited to above and QAPs shall be finalized during detailed engineering.

SUB-SECTION IA

CUSTOMER SPECIFICATION

(TECHNICAL SPECIFICATION (EOT CRANE)

CHAPTER-6

EOT CRANE FOR POWER HOUSE ~~AND GIS HALL~~

Contents

CHAPTER-6

EOT CRANE FOR POWER HOUSE ~~AND GIS HALL~~

6.1 System

The entire scope shall comprise two number EOT Cranes in the manner as follows:

(i) Power House EOT Crane – 63/8T (Minimum)

~~(ii) GIS Hall crane – 5 T (Minimum)~~

The details of the system will be as mentioned in the specification.

The capacities defined in these specifications is the minimum requirement, however, the Bidder shall provide the capacity of cranes as minimum defined herein or higher capacities as per requirement/calculations during detail engineering. If higher capacity cranes are required as per calculations during detail engineering, the same shall be provided by the Bidder.

6.2 Quantity

The supply of equipment would cover: -

(i) One (1) number 63/8 Ton (Min.), EOT crane (Main Hook capacity 63 Ton and Auxiliary hook capacity 8 Ton) complete with crane rails with foundation and clamping device, down shop loads etc.

~~(ii) One no 5 Ton, EOT crane complete with crane rails with foundation and clamping device, down shop loads etc. (with Pendent Control System)~~

(iii) One number lifting beam suitable for handling of generator rotor and Generator stator for Power House Crane.

(iv) One (1) set of mandatory Spares for operation and maintenance of above Cranes.

(v) One (1) set of mandatory tools and devices for operation and maintenance.

(vi) Oil and grease required for first filling with 10% excess quantity.

(vii) Three (3) sets each, of nylon slings / wire rope slings, of reputed make as per relevant standards.

6.3 Type and Rating

(1) Power House Crane

The powerhouse crane will be used principally for the installation and removal of various equipment including all heavy pieces of equipment located in the powerhouse such as generator rotor assemblies, stator sections and assemblies, and turbine runner assemblies, power transformer sub-assemblies and other E&M equipment. The assembled generator rotor shall be the heaviest assembly to be handled by the crane. Precise handling of valuable machinery at slow speed is required. The auxiliary hoist will be used for higher speed service, lesser weight assemblies and sub-assemblies.

~~(2) GIS Hall Crane~~

~~The GIS Hall crane will be used for the installation and removal of sub-assemblies and assemblies of various GIS equipment located in the GIS Hall.~~

6.3.1 Operating Parameters of Cranes

(1) Power House Crane

The EOT crane shall be a double hooks crane (one Main Hook, one Aux. Hook) and suitable for the following parameters/duties:

1.	Mechanism Class of Crane	M3 as per BIS:13834/	
2.	Capacity (in Tons) (Minimum)		
	1. Main Hook	63 T	
	2. Auxiliary Hook	8 T	
3.	Crane Span	12070 mm (approx.)	
4.	Normal speeds and micro speeds (inching) with full loads for Main Hook (63 Ton)- hoisting :		
	1. Normal speed	1.0 m/min	
	2. Micro speed	0.1 m/min	
5.	Normal speeds and micro speeds (inching) with full loads for Aux Hook		
	1. Normal speed	5.0 m/min	
	2. Micro speed	0.5 m/min	
6.	Trolley Travel (cross)		
	1. Normal speed	5.0 m/min	
	2. Micro speed	1.0 m/min	
7.	Bridge Travel (long)		
	1. Normal speed	10.0 m/min	
	2. Micro Speed	2.0 m/min	
8.	Max. Acceleration / deceleration Bridge travel and trolley travel	0.1 m/sec^2	
9.	Vertical Travel Reach of Crane Main & Aux Hook from the Floor level EL 1627.00 to Upper most position of hook	To be finalized during detailed Engineering.	
10.	Position of Hook from Rail C/L	U/stream	D/stream
1. Main Hook (63 T) (Tentative), The actual dimensions shall be finalized during detail engineering		▯ 800	▯ 3000
2. Auxiliary Hook (8 T) (Tentative), The actual dimensions shall be finalized during detail engineering		▯ 1800	▯ 2000
11.	Clearance from inside of end wall on		

	1. Service Bay End	≥ 3000 mm
	2. Power House End	≥ 3000 mm
12.	Runway, travel lengths	51 m (approx.) buffer to buffer
13.	Gantry rail level	EL 1637.30 m
14.	Length of runway	51 m + adjustment for buffer assembly for
		ends
15.	Trolley travel length	Max. Feasible for specified crane Span, shall ensure specified horizontal Hook
16.	Distance from rail C/L to nearest side travelling obstruction	
	1. Up-stream	≥ 350 mm
	2. Down-stream	≥ 350 mm
17.	Distance from the crane bridge end to nearest side travelling obstruction	
	1. Up-stream	≥ 150 mm
	2. Down-stream	≥ 150 mm
18.	Means for Micro speed for Inching Motion for main & auxiliary lifting	Step-less speed control
19.	Clearance of power house crane from ceiling (nearest overhead	500 mm approx

~~(2) GIS Hall Crane~~

~~It will be a single hook crane and will have pendent control system. EOT crane for GIS Hall shall be suitable for the following parameters / duties:~~

1.	Capacity (in Tons)	5 T
2.	Crane Span	12000 mm (approx.)
3.	Hoisting speed with full load	
	1. Normal speed	5.0 m/min
	2. Micro speed	0.5 m/min
4.	Trolley Travel (cross) speed	10 m/min
5.	Bridge Travel (long) speed	20 m/min
6.	Max. Acceleration/deceleration Bridge travel and trolley travel	0.2 m/sec^2