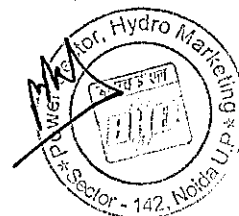


26.12 Schedule of Requirements

UNIT QTY LOCATION

- i) Suitable capacity of Air conditioning units to maintain the parameters as indicated in clause no 13.9 , complete with all accessories, auxiliaries, first charge of refrigerant, lubricating oil and drain water piping etc. For the following rooms.
- a) Control Room :
 - b) Conference room:
 - c) PLCC room :
 - d) GIS protection panel room
 - e) Elect. Workshop
 - f) Shift Engineer room
 - g) Communication
- ii) 415 V/240 V; 3 phase/ single phase A.C. distribution board with MCCB controlled incoming & outgoing feeders.
- iii) Wall mounted power supply control cubicle for each air conditioning unit
- (iv) Ducting complete with necessary longers, supports and accessories.
- (v) Diffusers complete with volume control dampers and frame work.
- (vi) Electrical and C&I equipments.

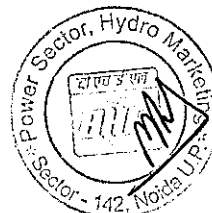


Annexure-I

Guaranteed & general technical particulars

1.	Split Air Conditioner			
a)	Make	-		
b)	Nominal capacity	K		
		Cal/hr.		
c)	Capacity at given ambient conditions	K		
		Cal/hr.		
d)	Material and thickness of refrigerating piping	-		
e)	3 phase, 415V 4 wire power required	KW		
f)	Whether technical literature attached	Yes/No		
1.1	Condensing (outdoor) unit			
i)	General	-		
a)	Overall dimensions LxBxH	mmxm mxmm		
b)	Weight	Kg.		
c)	3 phase, 415V wire power required	KW		
ii)	Compressor			
a)	Make of compressor			
b)	Model			
c)	Type of compressors			
d)	Number of each compressors	TR		
e)	Compressor motor rating	KW		
iii)	Condenser			
a)	Quality			
b)	Face (area)			
c)	No. of rows	m ²		
d)	Fins / CM.			
e)	Tube material			
f)	Fin material			
g)	No. and type of fans			
h)	Impeller diameter	mm		
i)	Speed	RPM		
j)	Total air quantity	m ³ /hr		
k)	Fan motor rating	(whethe r 1 ph./3 ph.		
1.2	Evaporator unit			
i)	General	-		
a)	Overall dimensions LxBxH	mmxm mxmm		
b)	Weight	Kg.		

Vishnugad Pipalkoti Hydroelectric Project



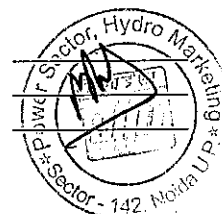
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TS- AIR CONDITIONING SYSTEM

ii)	Evaporator Fan			
a)	No. and type of fans	-		
b)	Impeller diameter	mm		
c)	Speed	RPM		
d)	Total air quantity	m ³ /hr.		
e)	Fan motor rating	KW		
iii)	Evaporator coil			
a)	Face area	-		
b)	No. of rows	-		
c)	Fins / CM	-		
d)	Tube material	-		
e)	Fin material	-		
iv)	Filter			
a)	Type	-		
b)	Size and thickness of each filter	-		
c)	No. of filters	-		
2.	Drain Piping			
a)	Material	-		
b)	Size-m	mm		
c)	Total length included (including fittings)	M		
3.	Fresh Air Fan Unit			
i)	Fan			
a)	Make	-		
b)	Model	-		
c)	Impeller diameter	mm		
d)	Speed	RPM		
e)	Capacity	m ³ /hr.		
ii)	Motor			
a)	Make	-		
b)	Motor rating	-		
c)	Type of enclosure	KW		
d)	Class of insulation	-		
iii)	Filter			
a)	Number of cleanable metallic viscous filters provided.	-		
b)	Size of each filter provided.	-		
c)	Number of dry fabric filter provided.	-		
d)	Size of each fabric filter provided.	-		
4.	Ducts, diffusers and accessories			
i)	Ducting			
a)	Material	-		
b)	Whether all the accessories as specified shall be provided. If No. indicate deviations	Yes/No		
	Thermal insulation			
	Material	-		
	Thickness	-		
	Mode	-		



Vishnugad Pipalkoti Hydroelectric Project



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d)	Make	-		
iii)	Acoustic lining			
a)	Material	-		
b)	Thickness	-		
c)	Mode	-		
d)	Make	-		
iv)	Diffusers			
a)	Material	-		
b)	Thickness	-		
c)	Whether duct layout drawing attached	Yes/No		
5.	Electrical			
5.1	Electrical protection provided for each motor.	Yes/No		
5.2	Type and material of wiring in the scope of the bidder.	-		
5.3	Details of material point on the condensing unit to which the purchaser's 3 P. 4 wire 415V feeder could be connected.	Yes/No		
6.	Controls			
6.1	Write up on control system furnished	Yes/No		
6.2	Protection provided for loss of refrigerant and over pressure due to condenser trouble.	Yes/No		
6.3	List of LED's provided.	Yes/No		
6.4	Size of control module.	Yes/No		
6.5	Technical literature of control module attached.	Yes/No		
6.6	List of local Instruments/Gauge to be provided.	Yes/No		
6.7	Whether wiring diagram shall be furnished with the equipment.	Yes/No		

Guaranteed Performance

We hereby declare that :

1. The Air Conditioning System shall maintain inside conditions as specified in the rooms.
2. Rating and performance figures of the equipment furnished by him are guaranteed.
3. Any defect/failure in our system shall be rectified/replaced by us free of cost up to the period of 12 months from the date of taking over at site.

Place :

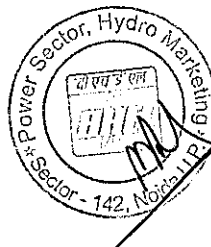
Signature of Bidder

Date:

Stamp

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Vishnugad Pipalkoti Hydroelectric Project



Vishugad Pipalkoti HEP(4x111 MW)---Electro-Mechanical Works

Tender No. ICB: THDC/RKSH/CC-297

Clarification No. 1 to Bidding Documents

S.N	Page	Section	Clause	Query/Clarification sought/suggestion proposed by Bidder(s)	Clarification / Reply by THDCIL
416	page 25-1	Section 25	25.1.1 Ventilation systems for Vishnugad Pipalkoti HEP covering areas such as Power house cavern, Transformer cavern, GIS floor, Main Access Tunnel, Cable Tunnel, Service Building, Dam galleries etc. including 0.415 kV Motor Control Centers (MCC), central control and annunciation panel, control boxes for local / remote control of ventilation systems, Butterfly Valve House etc.	Ventilation requirement for Dam galleries shall not be considered in Bidder's scope, as no details (type of ventilation and drawings) are available for the same.	No change. Layout drawings for dam gallery is enclosed as Annex-C (Project Layout and Drawings). Please refer Sl.No 7 of Amendment No. 1
417			Plot plan and all floor equipment layout where ventilation required.	Kindly provide the plot plan and all floor equipment layout where ventilation are required to be provided.	Please refer Sl.No 7 of Amendment No. 1
418	page 25-1	Section 25	25.1.1 a) Additional tunnels other than shown in Layout Plan of the project area	Please provide the Layout plan of the project areas showing various tunnels. Also provide the details of additional tunnels other than the shown in layout plan of the project.	Please refer Sl.No. 7 of Amendment No. 1 Ventilation system is to be executed as per layout of the project.
419	page 25-2	Section 25	25.2.2 Indoor Temperature & Humidity Conditions Desired For areas of power house served by ventilation system Maximum temperature = (25-28OC) Maximum Relative Humidity: - 65 % Bidder must refer to General Technical conditions specification for the actual site conditions. Those conditions would prevail for design of all systems. Also refer Clause no. 25.38.6, Bus-Duct Galleries, Page no. 25-40, It is indicated "Each of the four bus-duct galleries shall be supplied air from the GIS hall side by the above supply systems. Air at a temperature of about 34 OC shall discharge into the machine hall & shall pass out of the power house through the Main Access Tunnel".	1) Please confirm in which areas of power house, the specified temperature & humidity conditions shall be maintained. 2) We understand that the temperature shall not be maintained in Bus-duct galleries as per clause no. 25.38.6. Please confirm. 3) By using the Air washer unit / Ventilation plants, we can maintain the specified indoor temp. but specified Relative Humidity can not be maintained for the ventilation areas of power house. Please confirm.	1) No change in the condition indicated in Technical Specification. 2) The clause is self explanatory. 3) Except IPBD gallery clause is applicable for all Powerhouse areas.
420	page 25-4	Section 25	25.6.1.2 / 25.6.1.4 Maximum speed of the fan preferably shall not be more than 500 rpm so that... The impeller shall have die-formed blades welded to a rim.	We propose that the fan speed & impeller blade shall be as per manufacturer's standard & model selected. Please confirm.	Details shall be selected as per relevant IS/IEC/Govt. regulations. However sound level should not exceed 85db when measured at a distance of 1 meter.
421	page 25-17	Section 25	25.17.3 Reversible air flow ventilation system. The operation requirements of the fan are described in clause 25.38.1.2.	Details of Reversible air flow ventilation system is not there in clause no. 25.38.1.2. Please confirm the areas to be provided with Reversible air flow ventilation system.	Clause is self explanatory



**4x111MW VISHNUGAD PIPALKOTI HEP
HVAC
PROJECT SPECIFIC GENERAL
REQUIREMENTS**

SPECIFICATION No: PE-TS-413-571-11000A-A001

SECTION : I

SUB-SECTION : C2-B

REV. 00

DATE: JAN 2020

SECTION: I

SUB-SECTION: C2-B

**CUSTOMER SPECIFICATION
PROJECT SPECIFIC GENERAL REQUIREMENTS**

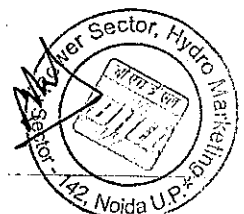
SECTION-1**GENERAL TECHNICAL REQUIREMENT**

- 1.0 GENERAL**
- 1.1 This part covers technical requirements which will form an integral part of the Contract. The following provisions shall supplement all the detailed technical specifications and requirements brought out in the bidding documents.
- 1.2 The scope covers to meet technical requirements for the design, engineering, manufacture, testing at manufacturer's works before dispatch, supply and services for insurance, transportation, delivery at project site, handling, storage and preservation at store/site, transport to the place of installation, complete work of site assembly, erection, testing at site and commissioning, assistance in operation & maintenance, handing over & remedial action, if any, upto defect liability period for electro-mechanical works as specified in various sections on EPC basis.
- 1.3 Any equipment, even though not covered in the specification in various sections but required for successful operation of the plant, shall be deemed to be covered in the scope of supply.
- 1.4 The contractor shall be responsible for complete engineering of the plant and prepare layout drawings of the underground power house, transformer cavern, GIS floor, cable tunnel, outdoor pothead yard, schematics, piping drawings, cable schedule, cable routing drawings, interconnection drawings etc. and submit the same for the approval of purchaser.
- 1.5 The parameters of the equipment specified are indicative only. The contractor shall prepare design memorandum containing the main parameters of all the equipment selected by him, Design Calculation, the safety factors adopted, the material used for fabrication of components in line with the latest design practice and the safety measures adopted against flooding and fire in the underground station. The contractor will submit this memorandum for purchaser's approval.
- 1.6 The contractor shall carry out studies wherever considered necessary to determine optimum parameter of the equipment such as high voltage withstand levels, short circuit withstand levels, Short-Circuit Calculations, Insulation co-ordination Studies, Voltage Drop Calculations, Earthing Network Calculations, Generator Earthing System Calculation, Selection of LV Breakers and Minimum Cable Cross Sections and to ensure successful synchronisation of the plant with 400 kV system and its commercial operation.
- 1.7 The parameters and quantities of equipment, layout drawings and schematics indicated in the Technical Specifications are for guidance purpose only. The EPC contractor shall optimise the parameters, layout etc in line with modern practices and for trouble free operation of the plant.

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- 1.8 The layout of 400KV switchyard shall be closely co-ordinated with the take off towers for 400 kV double circuit transmission lines.

2.0 DEVIATION & ALTERNATE PROPOSALS

- 2.1 The Bidders are not permitted to propose alternate technical proposals with their technical proposals. THDCIL will evaluate the technical aspects of the Bids to confirm that all technical specifications and requirements specified in the Bidding Documents have been met without any deviation, reservation or omission. Bids will be rejected in case of exceptions/deviations from the provisions, plans or specifications, material and services offered do not conform to the to the specifications and terms and conditions given in the Bidding document

3.0 COMPLETENESS OF FACILITIES

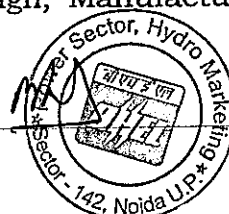
- 3.1 Bidders may note that this is a EPC turnkey contract. Each component of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure a completely engineered plant shall be provided.
- 3.2 All equipments furnished by the Contractor shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation of the equipment and for the safety of the operating personal, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions.
- 3.3 All similar standard components/ parts of similar standard equipment provided, shall be interchangeable with one another.

4.0 CODES & STANDARDS

- 4.1 In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this contract shall comply with all currently applicable statutory regulations and safety codes of the Republic of India.
- 4.2 Other International/ National standards such as DIN, VDI, BS, etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, along with the offer, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish the complete word to word translation of the standard that is normally not published in English.
- 4.3 As regards highly standardised equipments such as Hydro Turbine and Generator, National /International standards such as JIS, DIN, VDI, ISO, SEL, SEW, VDE, IEC & VGB shall also be considered as far as applicable for Design, Manufacturing and



Vishnugad Pipalkoti Hydroelectric Project



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Testing of the respective equipment. In addition, these standards shall be referred for the design of machine foundations, wherever specifically mentioned in the specifications. However, for those of the above equipment not covered by these National / International standards, established and proven standards of manufacturers shall also be considered.

4.4 In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.

4.5 In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect.

4.6 **Material Standards**

ASTM (American Society for Testing Materials), AISI (American Iron and Steel Institute) DIN (German Industrial Standards) and BSI (British Standards) are approved standards for the supply of materials.

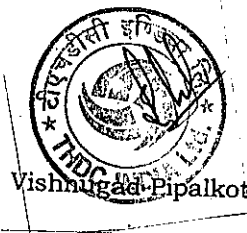
Material tests according to DIN 50049-3.1 C shall be provided for all important parts of the equipment such as: steel plates for parts under hydraulic pressure, all major castings (runner, shut-off valve, etc.), large forgings (turbine and generator shaft etc.), high stressed large bolts etc.

For less important parts, certificates according to DIN 50049-2.3 are acceptable.

Materials shall be new and of first-class quality, suitable for the purpose, free from defects and imperfections, and the classifications and grades in conformance with the latest issue of the respective ASTM, AISI, DIN or BS standard. Material to other standards may be used if approval by the Owner has been obtained. Material specifications, including grade or class data, shall be shown on the appropriate detail drawings submitted for review.

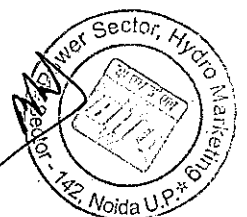
The Contractor shall indicate in the Technical Data Schedules, the materials and applicable standards for all major parts of the supply.

The materials shall be carefully selected for the intended purpose and due consideration of the site conditions and the tropical environment. Higher grade material shall be used where ordinary material is insufficient.



Vishnugad Pipalkoti Hydroelectric Project

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4 "Not withstanding reference made to various standards all equipment and works as per provisions and requirements of relevant and latest Indian Standards shall be acceptable".

4.7 Units of Measurements

The international SI-system of units shall be used for documents, calculations, correspondence, drawings, etc., relevant to the Tender and the subsequent Contract.

5.0 EQUIPMENT FUNCTIONAL GUARANTEE

5.1 The functional guarantees of the equipment under the scope of the Contract are given in the Technical Specifications. These guarantees shall supplement the general functional guarantee provisions covered under Defect liabilities given in General Conditions of Contract.

5.2 Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Contractor as specified elsewhere in this specification.

6.0 DESIGN FACILITIES

6.1 All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere.

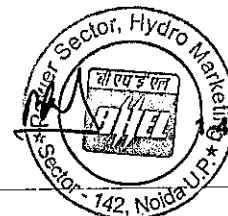
6.2 The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, assemblies and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

7.0 DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY CONTRACTOR

7.1 Bidders may note that this is a EPC turnkey contract. Each of the project component and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required to ensure a completely engineered plant shall be provided in respect of mechanical, electrical and power systems, control & instrumentation as per the scope defined in various sections of the Technical-Specifications.



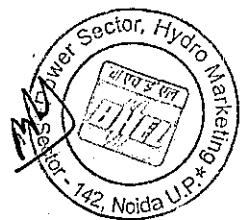
Vishnugad Pipalkoti Hydroelectric Project



- 7.2 The Contractor shall furnish engineering data in accordance with the schedule of information as specified in Technical Data Schedules and Technical Specification.
- 7.3 The number of copies/prints/CD-ROMs/manuals to be furnished for various types of document is given in **Annexure-I** to Technical Data Schedules.
- 7.4 **Engineering Information Submission Schedule**
- 7.4.1 Prior to the award of Contract, a Detailed Engineering Information Submission Schedule shall be tied up with the Employer. For this, the bidder shall furnish a detailed list of engineering information along with the proposed submission schedule. This list would be a comprehensive one including all engineering data / drawings / information for all bought out items and manufactured items. The information shall be categorized into the following parts.
- i) Information that shall be submitted for the approval to the Employer before proceeding further, and
 - ii) Information that would be submitted for Employer's information only.
- 7.4.2 The Engineering Information Schedule shall be updated month wise.
- 7.4.3 The schedule should allow adequate time for proper review and incorporation of changes/ modifications, if any, to meet the contract without affecting the equipment delivery schedule and overall project schedule. The timely submission of drawings and data is as important to manufacture and delivery of equipment and hardware and this shall be duly considered while determining the overall performance and progress. The review of these data by the Employer will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under specifications. This review by the Employer may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the Employer shall not be construed by the Contractor, as limiting any of his responsibilities and liabilities for mistakes.
- 7.4.4 All engineering data submitted by the Contractor after final process including review and approval by the Employer shall form part of the Contract Documents and the entire works covered under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the Engineer in writing.
- 7.4.5 The documentation that shall be provided by the Contractor is indicated in the various sections of specification. This documentation shall include but not be limited to the following:



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7.5

Basic Engineering Documentation

Prior to commencement of the detailed engineering work, the Contractor shall furnish a Project Definition Manual within 12 weeks from the date of the Notification of Award. This manual shall contain the following as a minimum:

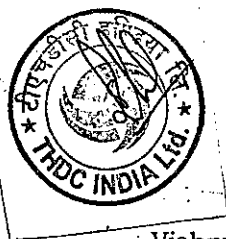
- i) System description of all the mechanical, electrical, control & instrumentation.
- ii) Sizing criteria of all the systems, sub-systems/ equipments/ structures/ equipment foundations along with all calculations justifying and identifying the sizing and the design margins.
- iii) Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups.
- iv) Operation Philosophy and the control philosophy of the Main Plant and other plants.
- v) General Layout plan of the power station incorporating all facilities in Bidder's as well as those in the Employer's scope. This drawing shall also be furnished in the form of CD-ROMs to the Employer for engineering of areas not included in bidder's scope.
- vi) Basic layouts and cross sections of the main plant building (various floor elevations) and other areas including interface-areas included in the scope of the bidder.
- vii) Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.
- viii) The successful bidder shall furnish within three (3) weeks from the date of Notification of Award, a list of contents of the Project Definition Manual (PDMs), which shall then be mutually discussed & finalised with the Employer.

7.6 Detailed Engineering Documents

7.6.1

The contractor shall submit to the purchaser the following drawings/documents after the award of contract expeditiously in a sequential manner. Drawings shall be submitted in AUTOCAD format and the documents shall be submitted in PDF format. The bidder shall indicate separately the time schedule for submission of drawings for all the equipment covered in different sections for the approval of Purchaser, keeping in view the overall commissioning schedule of the project.

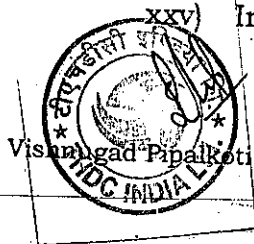
- i) General layout plan of the station.
- ii) Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the project.
- iii) Flow diagrams, Process & Instrumentation Diagrams
- iv) Piping composite layout drawings.



Vishnugad Pipalkoti Hydroelectric Project

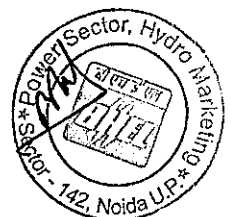


- v) Purchase specifications/ technical data sheets for all bought out and manufactured items.
- vi) Detailed design calculations for components, system, equipments etc., wherever applicable including sizing calculations for all auxiliaries.
- vii) Transient & hydraulic analysis of the project components and system wherever applicable.
- viii) Comprehensive list of all terminal points which interface with Employer's facilities giving details of location, end connection details, forces, moments etc.
- ix) Power supply single line diagram, block logics, control schematics, electrical schematics, etc.
- x) Protection system diagrams and relay settings.
- xi) Cables schedules and interconnection diagrams.
- xii) Cable routing plan.
- xiii) Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, installation drawings for field mounted instruments, logic diagrams, control schematics, wiring and tubing diagrams of panels and enclosures etc. Drawings for open loop and close loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc.
- xiv) Alarm and annunciation/ Sequence of Event (SOE) list and alarms & trip set points.
- xv) Sequence and protection interlock schemes.
- xvi) Type test reports, insulation co-ordination study report and power system stability study report.
- xvii) Control system configuration diagrams and card circuit diagrams and maintenance details.
- xviii) Detailed software manuals & source software listing.
- xix) Detailed flow chart for digital control system.
- xx) Mimic diagram layout.
- xxi) Model study reports wherever applicable.
- xxii) Functional & guarantee test procedures and test reports.
- xxiii) Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.
- xxiv) For equipment foundation, separate composite general arrangement drawings for equipment foundation shall be furnished by the bidder including the location of pockets/bolts/inserts/embedments/pedestals and extent of grouting, point of application of loads etc.
- xxv) Instruction Manual as per Clause No. 7.9.



Vishnugad Pipalkoti Hydroelectric Project

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- 7.6.2 The Contractor's while submitting the above documents/ drawings for approval/ reference as the case may be, shall mark on each copy of submission the reference letter along with the date vide which the submissions are made.

7.7 Engineering Drawings

- 7.7.1 All documents submitted by the Contractor for Employer's review shall be in electronic form (soft copies) along with the desired number of hard copies as per Annexure-I of the Technical Data Schedule. The soft copies to be supplied shall be either in CDs, DVD or through direct transfer via E-mail, etc. The drawings submitted for approval could be in the image form.
- 7.7.2 All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, weight of each component, for packing and shipment, the external-connection fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules.
- 7.7.3 Each drawing submitted by the Contractor (including those of sub-vendors) shall bear a little block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number and the name of the Project, drawing number and revisions. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawings shall be in English. All the dimensions should be in metric units.
- 7.7.4 The drawings submitted by the Contractor (or their sub vendor's) shall bear Employer's drawing number in addition to contractor's (their sub-vendor's) own drawing number. Employer's drawing numbering system shall be made available to the successful bidder so as to enable him to assign Employer's drawing numbers to the drawings to be submitted by him during the course of execution of the Contract.
- 7.7.5 The Contractor shall also furnish a "Master Drawing List" which shall be a comprehensive list of all drawings / documents / calculations envisaged to be furnished by him during the detailed engineering to the Employer. Such list should clearly indicate the purpose of submission of these drawings i.e. "FOR APPROVAL" or "FOR INFORMATION ONLY".
- 7.7.6 Similarly, all the drawings / documents submitted by the Contractor during detailed engineering stage shall be stamped "FOR APPROVAL" or "FOR INFORMATION" prior to submission.
- 7.7.7 The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the

project. The review of these documents / data / drawings by the Employer will cover only general conformance of the data / drawings / documents to the specifications and contract, interfaces with the equipments provided by others and external connections & dimensions which might affect plant layout. The review by the Employer should not be construed to be a thorough review of all dimensions, quantities and details of the equipments, materials, any devices or items indicated or the accuracy of the information submitted. The review and / or approval by the Employer shall not relieve the Contractor of any of his responsibilities and liabilities under this contract.

7.7.8 After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Employer. Also soft copies of Approved drawings shall be supplied by contractor either in DVDs or Hard drives.

7.7.9 All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Contractor's risk. The Contractor is expected not to make any changes in the design of the equipment/system, once they are approved by the Employer. However, if some changes are necessitated in the design of the equipments/system at a later date, the Contractor may do so, but such changes shall promptly be brought to the notice of the Employer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specifications.

7.8 As Built Drawings

7.8.1 After final acceptance of individual equipment / system by the Employer, the Contractor will update all original drawings and documents for the equipment / system to "as built" conditions.

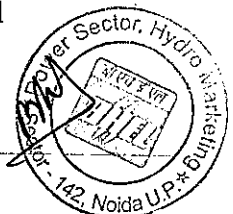
7.8.2 Drawing must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to Engineering Schedule prior to submission to the Employer. In case drawings are found to be submitted without proper endorsement for checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data / drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.

7.8.3 All engineering data submitted by the Contractor after final process including review and approval by the Employer shall form part of the contract documents and the entire works covered



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under these specification shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the Engineer-in-charge in writing.

7.9 Instruction Manuals

7.9.1 The Contractor shall submit to the Employer, draft Instruction Manuals for all the equipments covered under the Contract. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project and shall be submitted during detailed Design Stage. After finalisation and approval of the Employer the Instruction Manuals shall be submitted as indicated in **Annexure-I**. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals have been supplied to the Employer. The Instruction Manuals shall comprise of the following.

7.9.2 Erection Manuals

The erection manuals shall be submitted at least three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum.

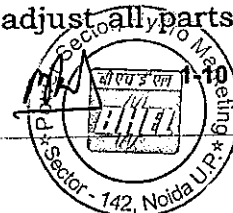
- i) Erection strategy.
- ii) Sequence of erection.
- iii) Erection instructions.
- iv) Critical checks and permissible deviation/tolerances.
- v) List of tool, tackles, heavy equipments like cranes, dozers, etc.
- vi) Bill of Materials
- vii) Procedure for erection.
- viii) Procedure for initial checking after erection.
- ix) Procedure for testing and acceptance norms.
- x) Procedure / Check list for pre-commissioning activities.
- xi) Procedure / Check list for commissioning of the system.
- xii) Safety precautions to be followed in electrical supply distribution during erection

7.9.3 Operation & Maintenance Manuals

7.9.3.1 The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall be in sufficient detail to enable the Employer to operate, maintain, dismantle, reassemble and adjust all parts of



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the equipment. They shall give a step by step procedure for all operations likely to be carried out during the life of the plant/equipment including, operation, maintenance, dismantling and repair. Each manual shall also include a complete set of drawings together with performance/rating curves of the equipment and test certificates wherever applicable. The contract shall not be considered to be completed for purposes for taking over until these manuals have been supplied to the Employer.

7.9.3.2 If after the commissioning and initial operation of the plant, the manuals require any modification/ additions/ changes, the same shall be incorporated and the updated final instruction manuals shall be submitted to the Employer for records.

7.9.3.3 A separate section of the manual shall be for each size/ type of equipment and shall contain a detailed description of construction and operation, together with all relevant pamphlets and drawings.

7.9.3.4 The manuals shall include the following

- i) List of spare parts along with their drawing and catalogues and procedure for ordering spares.
- ii) Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation.
- iii) Where applicable, fault location charts shall be included to facilitate finding the cause of mal-operation or break down.
- iv) Detailed specifications for all the consumables including lubricant oils, greases, chemicals etc. required for the complete plant.
- v) On completion of erection, a complete list of bearings/equipment giving their location, and identification marks etc. shall also be furnished to the Employer.

7.10 Plant Handbook and Project Completion Report

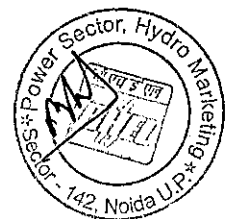
7.10.1 Plant Handbook

The Contractor shall submit to the Employer a preliminary plant hand book preferably in A-4 size sheets which shall contain the design and performance data of various plants, equipments and systems covering the complete project including

- i) Design and performance data.
 - ii) Process & Instrumentation diagrams.
 - iii) Single line diagrams.
 - iv) Sequence & Protection Interlock Schemes.
- Alarm and trip values.
Performance Curves.



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vii) General layout plan and layout of main plant building and auxiliary buildings

viii) Important Do's & Don't's

The final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.

7.10.2 **Project Completion Report**

The Contractor shall submit a Project Completion Report at the time of handing over the plant.

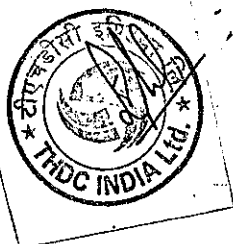
7.11 **Clearance of Employers' Drawings:**

7.11.1 During detailed Engineering contractor will check the interface of relevant structural general arrangement drawings, foundation drawings, RCC drawings and architectural plan/elevation drawings furnished by the Employer for various areas and forward his consolidated observations/comments within three (3) weeks from the date of forwarding the drawings by the Employer.

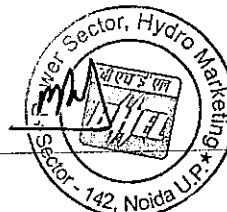
8.0 **Monthly Engineering Progress Report**

8.1 During the period of contract, the Contractor shall, before the tenth (10th) day of each calendar month, submit monthly progress reports in a format acceptable to the Purchaser, detailing the progress of the work during the preceding month. The report shall contain but are not be limited to the following information:

- i) A general description of the Works performed during the reporting period on each main activity and includes any notable problems which were encountered.
- ii) The total overall percentages of erection works completed, with reference to the CPM programme. Appropriate comments shall explain differences if any.
- iii) The percentages of each main work activity completed during the reported month with reference versus the scheduled programme. Appropriate comments shall explain differences if any.
- iv) A list of all activities of scheduled and actual progress during the reporting period including actual starting dates versus scheduled starting dates and actual completion dates versus scheduled completion dates for each activity. Appropriate remarks shall explain differences if any.
- v) A list of activities scheduled to be started within the next period of two (2) months, with expected starting and completion dates. If the expected starting and / or completion dates are different from those shown on the CPM programme, an explanation shall be given.
- vi) A list of local manpower (by trade classification) employed during the reporting period.



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- vii) A list of expatriate personnel (by position) employed during the reporting period.
- viii) A list of the Contractor's Equipment and materials presently located at the Site. Also a list of equipment and materials, which arrived at the Port of arrival and is in the process of being cleared through customs.
- ix) Progress photographs of significant events. The Purchaser may direct the inclusion of specific photographs if deemed necessary.
- x) Main items of temporary facilities constructed during the reporting period.
- xi) A statement detailing the status of progress on the overall programme and how to regain any lost time or set-backs which may have occurred.
- xii) A list of inoperable temporary equipment, and the estimated date when the repair will be completed.
- xiii) A statement concerning potential problems and recommendations on how they could be resolved.
- xiv) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission
- xv) Drawings which were not submitted as per agreed schedule.

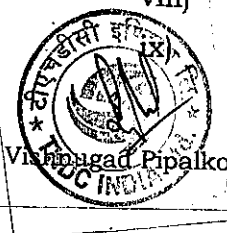
8.2 The draft format for this report shall be furnished to the Employer after award of the contract, which shall then be discussed and finalised with the Employer.

9.0 Programme of Work Schedule

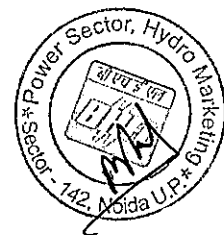
9.1 According to the relevant articles in the 'Condition of Contract, the progress of the work shall conform to the basic Programme of Work Schedule on which the Contract is based.

9.2 The detailed programme / schedule of work shall be submitted in accordance with the Contract Conditions, and shall include the following information ;

- i) Design work
 - ii) Procurement
 - iii) Shop work and testing
 - iv) Transportation to the Site
 - v) Loading & un-loading
 - vi) Intermediate storage
 - vii) Storage and handling at site
 - viii) Erection, testing and commissioning
- Trail run operation



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- x) Performance guarantees test
- xi) Removal of erection equipment and clearing of Site
- xii) Interdependence with work of other contractors.

9.3 The Contractor shall pay particular attention to the dates established for the submission of "installation and foundation" drawings with loading data, anchoring details, recesses, block-outs etc., and all information necessary for the preparation of the civil work design drawings.

9.4 Since the Schedule dates are dependent on the progress of other contracts, the Contractor shall suitably co-ordinate his operations at the Site with those of other contractors.

10 Painting and Surface Treatment

10.1 Scope

All the equipment furnished and installed by the Contractor shall be completely painted for final use, with the exception of those parts or surfaces that are expressly designated as unpainted. Surfaces to be painted shall receive the preparatory treatment and number of coats approved by the Owner. The Contractor shall perform all painting work in the shop, before shipment, followed by a field touch-up during or after installation. If accepted by the Owner, the Contractor may apply the last coat of paint at the site instead of applying it in the shop.

10.2 Standard Products

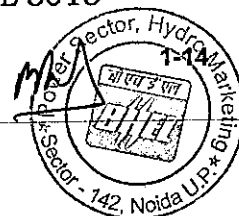
All materials, supplies, and articles furnished shall be the standard products of recognized reputable manufacturers, and shall be subject to Owner's review for acceptance.

10.3 Colour Schedule

	Colour	Standard Ref.
• Raw water pumps	Mint green	RAL 6029
• Raw water strainers	Mint green	RAL 6029
• Heat exchangers	Mint green	RAL 6029
• Turbines	Silicon gray	RAL 7032
• Governors	Silicon gray	RAL 7032
• Oil pressure piping	Yellow orange	RAL 2000
• Oil purification system	Yellow orange	RAL 2000
• Lubrication oil piping	Yellow orange	RAL 2000
• Air compressors	Sky blue	RAL 5015



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- Air piping Light blue RAL 5012
- Tops of generators To be decided at a later date.
- Transformers - do -
- Switchyard equipment - do -
- Enclosures for electrical power equipment Melon yellow RAL 1028
- Enclosures for electrical control and protection equipment Pearl white RAL 1013

11.0 Fluids and lubricants

11.1 General

The Contractor shall deliver to the Owner all equipment complete with initial fill of fluids, grease or lubricants, transformer oil, and replace any quantity used up or lost during installation and testing.

11.2 Compatibility

The oil used for the lubrication and oil pressure systems for the turbine, governor, and generator shall be ensured to be of the same type. In case of any deviation, approval of the owner shall have to be obtained by giving full justification as the above can not be allowed in normal case.

The Contractor shall coordinate with the owner, the type of fluids and lubricants used in the bearings.

Upon completion of the design, the Contractor shall furnish a tabulation confirming the quantities and types of fluids and lubricants required for initial application for each item of equipment.

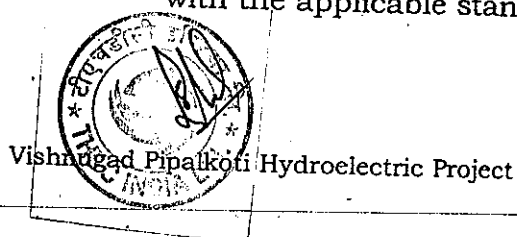
11.3 Supply

The Contractor shall furnish the following:

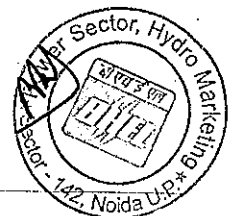
- All oil for initial filling of all equipment supplied, plus 10% additional.
- Grease if required for initial filling of all of the equipment, plus 10% additional.
- Flushing fluids to flush and clean all systems.

11.4 Pipe Connections

External connections for all equipment shall be in accordance with the applicable standards.



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Internal connections shall be in accordance with standards selected by the Contractor and accepted by the Owner.

Adequate pipe supports and mounting hardware shall be provided for all piping in the Contractor's supply.

11.5 **Pressure Tests**

Unless otherwise specifically accepted in the Contract Documents, equipment, vessels and tanks under internal pressure during service shall be subject to hydrostatic pressure testing. The test pressure shall be 1.5 times the maximum working pressure of the respective equipment, vessel or tank.

The test pressure shall be applied for a period of 8 hours without showing leaks or drop in pressure.

12.0 **Dimensional Checks and Visual Inspection**

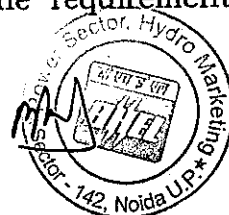
Dimensional checks shall be performed on all major parts, components and partial assemblies, especially when close tolerances and fits are involved (tolerance of shafts, between stationary and moving parts, connecting dimensions for the assembly with other supplies, etc.). If the dimensional checks show discrepancies in measurement which may affect the fit, assembly or dismantling of the respective part or component, the same have to be corrected correspondingly. Such correction or modification shall, however, in no way lead to sacrifices with respect to reliability of operation or inter-changeability, and shall be performed only after the agreement of the Owner has been obtained. If the correction or modification cannot be carried out in accordance with the terms mentioned above, the part or component concerned may be subject to rejection. Faulty machine parts or equipment shall by no means be delivered.

All major finished surfaces shall be subject to visual inspection in the presence of the Owner. Runner blades, stay vanes and wicket gate feather profiles shall be checked by means of templates which should be prepared/manufactured exactly as per drawing, as far as possible.

13.0 **Functional Tests**

Functional tests on partial assemblies and/or complete assemblies shall be carried out as much as possible already in the manufacturer's workshops. Such tests shall be performed as far as possible under operation-like conditions.

When requested by the Owner, the functional tests shall be repeated until full proof has been obtained that the functioning of the assemblies will comply with the requirements of the Contract Documents.



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14.0 **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 leveling and anchoring the equipment prior to grouting.

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

15.0 **Electrical Equipment**

15.1 **General**

The electrical equipment delivered under this contract shall be new and of high quality, suitable for the purpose it is intended for, free from defects and imperfections, and it shall be of the classifications listed herein, or their equivalents, subject to acceptance by the Owner.

The equipment shall meet the applicable IEC Recommendations, international standards such as ANSI - IEEE - DIN - SEN or others, that can be shown to be comparable to these. The IEC and IEEE recommendations for approval of equipment and tools are applicable.

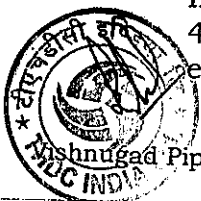
The equipment design shall be suitable to render satisfactory operation under the conditions prevailing at the site, and the equipment shall operate satisfactorily under normal load and voltage variations. The design shall further include all necessary provisions ensuring the safety of the operating and maintenance personnel.

Each equipment assembly, or unit containing electrical devices and wiring, shall be completely wired in the shop. Wiring shall be neatly arranged and protected against mechanical damage, terminating in terminal blocks located in a connection box or cubicle, on or near the unit.

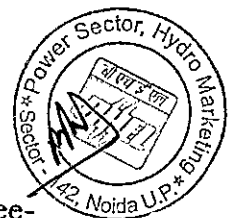
15.2 **Auxiliary voltages**

15.2.1 **AC power**

Three phase- system with grounded neutral for feeding three-phase and one phase consumers (connected between phase and neutral), type TN-C according to IEC Publication 364-3, 415/240 V $\square$ 10%, 50 Hz $\square$ 3%. Frequency variation under extreme condition may be $\square$ 5%. All motors and other electrical



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apparatus should be designed to work continuously under $\pm 5\%$ frequency variation and $\pm 10\%$ voltage variation.

15.2.2 DC power

D.C. Systems, ungrounded, with earth fault detection

220V + 20% to -25% for the supply of main control circuits for high and medium voltage switchgear, protection circuits and to other larger essentials load.

48V + 20% to -25% for the supply to EPABX etc.

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

15.3 Temperature rises

The temperature rise for the major electrical components is cited in the respective chapters of these Contract Documents. Whenever no special mention of temperature rise is made, it shall be understood that the temperature rise is in accordance with the IEC Recommendations.

15.4 System Parameter

	Nominal	Variation under worst condition
Voltage	400KV	360-440KV
Frequency	50Hz	47.5-52.5Hz

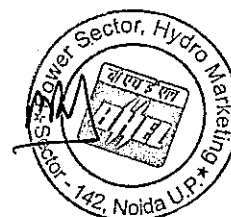
16.0 Electrical Equipment Enclosures

16.1 General

All electrical equipment, apparatus and devices shall be of suitable design for satisfactory operation under the conditions prevailing at the Site. The equipment shall operate satisfactorily under normal load and voltage variations in accordance with IEC Publications.

The design shall also include all necessary provisions ensuring the safety of the operating and maintenance personnel.

All electrical connections and contacts shall be of ample cross section and capacity for carrying continuously the specified currents without undue heating and shall be secured by bolts or set-screws of ample size, fitted with locknuts or lock washers of approved types.



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Unless otherwise expressly stated, conductors and all other current carrying parts shall be electrolytic copper in accordance with approved, applicable standards.

Cubicles and other enclosures containing electrical equipment shall be especially treated to prevent corrosion. All cubicles shall be provided with a door switched lighting fixture and a single phase socket for power outlet.

All interior surfaces of electrical apparatus, enclosures etc. including contactors, relays, coils, etc., shall be treated in an approved manner to prevent mould growth. Such treatment shall in no way interfere with the proper operation of the equipment either electrically or mechanically.

Bigger assemblies such as switchboards, etc., shall be designed to present suitable transportation divisions adapted to the local conditions within the plant.

Unless otherwise specifically called for or described in these Contract Documents all electrical appliances shall conform to the applicable IEC Publications.

16.2 Construction requirements

All cubicles and enclosures shall be of good quality standard production subject to approval by the Owner. Cubicles shall be free floor standing type, of rigid frame covered with removable steel sheets. The frame shall be bolted to the floor. There shall be provision and enough space for entrance of cables from above or below as necessary. The cubicles shall be ventilated if needed; in this case removable filter inserts shall be fitted to the air entrance openings. Provision for cable fastening shall be inside the cubicles and enclosures, and sufficient space from cable fastenings to nearest terminal. All control and indicating instruments such as contactors, circuit breakers, auxiliary relays, indicating instruments, switches etc., shall be functionally displayed in appropriate location. All indicating devices shall be visible with the door closed. The layout is subject to the approval of the Owner.

If required, flush mounted hinged steel doors with latches shall be available: doors shall be with approved locks. The locks shall be of the same type throughout the plant. All panels and cubicles shall have a uniform appearance.

The cubicles and enclosures shall be of protection class IP 54 or higher according to their location, unless otherwise, there are constraints which may prevent to maintain above protection class and same shall be justified by the contractor and approval shall be taken from the owner for the deviation. All cubicles shall be equipped with automatically controlled heating elements for protection against internal condensation and moisture.

All panels/cubicles shall have approximately 20% space for mounting of future devices.

16.3 Wiring

Wiring within cubicles and equipment enclosures shall conform to requirements of this section unless otherwise specified. Control wiring shall be stranded copper and shall be not smaller than 2.5 mm², except as otherwise agreed by the Owner. Larger size wiring shall be used where needed for the current carrying capacity requirements.

Cables shall have at least 1100 V PVC insulation except for 220V DC and telemetering or communication system equipment for which 650V and 300V rating respectively are acceptable. .

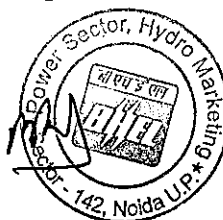
For current and potential transformer secondary circuits the cross section of the conductors shall not be less than 6 mm² and 4 mm² respectively.

Wiring shall terminate at terminal blocks at one side only. Where tap connections are required they shall be made on terminal blocks. Wiring shall be neatly arranged and laid in conduits accessible from the front door. The conduits shall not be filled more than 70%.

Each cubicle shall be provided with an earthing bar (PE) of sufficient cross section carrying any possible fault current without undue heating. All metallic parts of the cubicle not forming part of the live circuits, all instrument transformer terminals to be earthed and other earthing terminals as well as all cable screens and PE-wires shall be connected to the earthing bar.

16.4 Terminal blocks

The terminal blocks shall be located to allow a neat and easy connection work and shall be safely accessible while the equipment is in service. Control circuits and power circuits shall be completely separated by use of divided or separate terminal blocks. Power terminal blocks shall be rated in accordance with applicable standards, and shall be provided with covers. Control wiring terminal shall be equipped with facilities for opening the circuit. It shall be possible to interchange a single terminal block for a new one without dismantling a whole row. Current transformer terminal blocks shall have provisions for short circuiting. Not more than two wires shall be connected to any one terminal. Terminal blocks using screws acting directly on the wire will not be accepted. At least 20% spare terminals shall be provided. Terminals shall be marked with printed labels.



16.5 Grounding

The Contractor shall connect all equipment included in the scope of delivery to the grounding system of the Powerhouse, transformer substation and the switchyard. Two grounding mat i.e. power house grounding and transformer substation grounding shall be connected for effective grounding system. If necessary, third grounding mat shall be laid at T.R.T. outlet and shall be interconnected. In addition to the grounding through cable screens, all equipment such as cubicles, motors, etc. shall be connected directly to the grounding system using copper wire of area not less than 50 mm² at two different points. In general all iron parts such as supports, covers, railing, etc. shall be connected to the grounding system. Each conductor shall have its own separate connection point. Pressed on closed shoes shall be used for connections to bars.

16.6 Protection devices

For short circuit and overload protection of lower rating power and control circuits, moulded case circuit breakers and MCBs respectively shall be used.

Outlets from AC (and DC) distribution panels are protected in their respective panels.

16.7 Marking of equipment and wiring

All internal equipment and wiring shall be neatly and clearly marked as indicated on the schematic and wiring diagrams. Internal wiring and cables shall be marked with sleeve type engraved marking. Marking system and marking material shall be subject to approval by Owner. Identification of the respective conductors shall be in accordance with the requirements of IEC publication 204. In cable having 5 conductors or more the individual conductors shall be numbered throughout the entire length. In cables having less than 5 conductors colour coding in accordance with IEC Recommendations 204 shall be used.

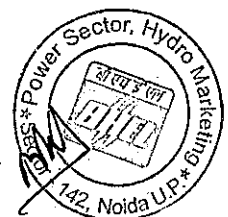
16.7.1 Colour Coding for Electrical Connections

Live parts of electrical connections shall be colour coded as follows:

Conductor Designation	Coding Alphanumeric	Symbol	Colour
A.C. network 3 phase	phase 1	R	red
	phase 2	Y	yellow
	phase 3	B	blue
	neutral	N	black
A.C. single phase	phase	P	red
	neural	N	black
	earth	E	green-yellow
D.C. network	positive	a	red



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negative

b

black

16.7.2 Colour Coding for Mimic Diagrams

Mimic diagrams to be arranged on switchgear cubicles, control panels/desks, etc., shall be colour coded as follows:

420 kV	Gold
13.8 KV	signal red
415 V	black
220 V D.C.	violet
48 V D.C.	white

Note: Colours given under 2.17.7.1 and 2.17.7.2 shall be finally agreed upon during detailed design.

16.8 Compatibility

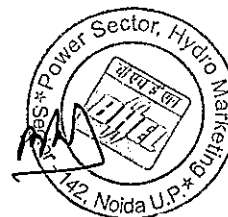
Equipment serving similar or same purpose shall as far as possible be of same make and type. All indicating lights shall use same type of light bulbs.

17.0 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 Owner 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 either by 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.

18.0 Control Concept

The operations, control procedures, monitoring and protective devices for the plant are described in chapter of, Control and Monitoring system and protection system. The Contractor shall furnish all equipment required for effecting the intended method of operation and control, within the plant.



Primarily, control of equipment shall be automatic, but manual control and/or local control of the various components shall also be possible from control boards during operation, testing and maintenance of the respective components. Interlocking devices shall be incorporated in the control circuits in the quantity needed to guarantee correct sequence of operation of the equipment. Protective devices shall be supplied and the particular needs of equipment furnished with the aim of ensuring a safe and reliable operation of the plant in the event of electrical and mechanical disturbances or in case of mal-operation by the plant personnel.

In the design of the control systems for different parts of the plant the Contractor shall take care of standardizing the components used.

Where programmable logic controllers are used these shall to the extent possible be compatible. Where control systems are based on relays, sufficient information on the operating status shall be provided through potential free change-over contacts connected to outgoing terminals for comfortable connection.

19.0 Handling Devices

Lifting lugs, brackets, eyes, and other items required for attaching lifting devices shall be provided on all of the major components of the equipment weighing more than 25 kg. All slings and lifting devices required for attachment to the components and assemblies and to a crane hook for handling during erection and later disassembly shall be furnished.

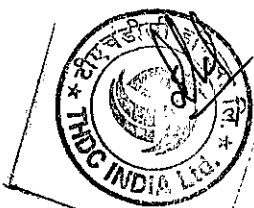
20.0 Control Switches, Indicating Lamps and Instruments

20.1 General

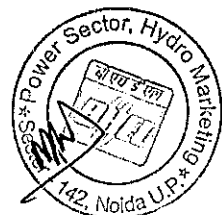
Control switches, indicating lamps and instruments shall be arranged so that all parts are readily accessible for servicing without the necessity to remove other devices, terminal blocks or excessive amount of wiring.

All control switches and indicating devices mounted in cabinets and enclosures shall be visible with the doors closed.

Identification nameplates shall be provided for all control switches, indicating instruments and lamps, in accordance with clause 2.22, Nameplates.



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Instruments and controls shall be located so that their dials, indicators and nameplates are clearly readable. Data for all instruments to be provided, including type, size, scale range, electrical ratings, nameplate and name of manufacturer, shall be furnished. Steel panels shall be provided for group mounting of the instruments. All instruments shall be of an approved type and shall match, insofar as practicable, the other instruments with which they are associated; their dial type, scaled markings and units, type of connection and mounting, shall be coordinated. All piping and tubing required for instruments shall be furnished and installed.

All instruments and control switches shall be furnished with necessary auxiliaries, i.e. resistors, shunts etc.

20.2 **Control switches**

The switches and push-buttons shall be provided with ample contact ratings, suitable cam or block arrangements necessary for the control functions on 415 V AC or 220 V DC circuits. The control switches used in mimic diagrams shall be of discrepancy type with built in lamp indication.

20.3 **Indicating and signalling lamps**

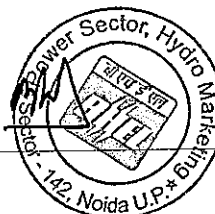
Each indicating and signalling lamp shall have a removable cap which can be inscribed with wording and shall not be affected with the heat of the lamp. Light bulbs shall be replaceable from the front of the panel. The indicating and signalling lamps shall be of the same size and type.

20.4 **Integrating instruments**

The WH and VARH meters shall be of the semi-flush-mounted type. Each meter shall be connected to terminal blocks suitable for opening and short circuiting for testing purposes. The meter cases shall be dust-tight and with removable covers. The meters shall be three-phase, three element, equipped with an impulse contact mechanism, potential free for remote metering purposes, and shall be suitable for continuous operation from secondaries of potential transformers and from secondaries of current transformers. The meters shall be provided with primary-rated, direct reading registers, with five or more dials or digits and a suitable multiplier. The meters for the outgoing lines shall be of the two-way type and all meters shall have mechanism to prevent negative registration.

The meters shall have built in over-voltage protection and an isolation according to IEC Publication 521. The tolerance ambient temperature range of the meters shall be 0 to 50 degrees C.

The class of the WH meters shall be 0.2 and the VARH meters 0.5 according to IEC Publication 687 unless otherwise stated in the particular technical specifications.



20.5 Measuring converters

The converters shall be suitable for direct connection to the secondary circuits of the potential and current transformers used, or other sensors, each as they apply. The converters shall be static type, having all accessories to provide and output signal of 4-20 mA, filtered DC. Power supply voltage used.

For the measuring converters the following minimum requirements shall be fulfilled :

- Current transducers shall be single-phase, of accuracy class 0.5 or better.
- Voltage transducers shall be single-phase of accuracy class 0.5 or better.
- W and VAR transducers shall be two element, three-phase. Accuracy class of the transducers shall be 0.5 or better.

20.6 Measuring Transformers

Potential transformer secondary windings shall be rated $110/\sqrt{3}$ V

Current transformer secondary windings shall have a rated current of 1A/ 5A.

21.0 Nameplates

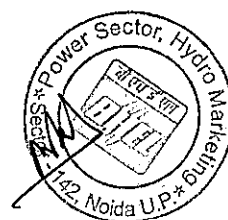
Each major and auxiliary item of equipment shall have a nameplate permanently affixed thereto, or as directed, showing in a legible and durable manner the serial number, name and address of the manufacture, rated capacity, speed, electrical characteristics, and other significant information, as applicable. Nameplates of distributing agents only will not be acceptable. Nameplates shall also be provided for identification of all panels, cubicles and other enclosures as well as for panel-mounted devices, dials, gauges instruments and control devices. Nameplates shall be marked with the nomenclature and units of measurement used in the metric system (SI- units), and a schedule of such markings shall be submitted for review. Type of nameplates and wording on identification nameplates shall be submitted in English for approval. The Owner will translate the text if needed and the Contractor shall furnish and attach the nameplates.

21.1 Cautionary signs

English shall be used as prime language on nameplates required for caution or warning signs, identification plates for control devices, and instruction plates.



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21.2 **Other nameplates**

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Nameplates which are not required for the operation of the equipment and are not of a cautionary or warning nature required for the safety of personnel, i.e. showing motor speeds, horsepower, electrical characteristics, name and address of manufacturer and other information necessary for maintenance and repair work are to be in English.

22.0 **Equipment Service Conditions**

All equipments and material supplied under this contract shall be suitable for operation under the following service conditions

23.0 **Model, routine and type tests:**

23.1 Model Test shall be performed on Turbine as per clause 2.1.4.6 of the Technical Specifications. Prices quoted for Turbine shall, therefore, be inclusive of the cost of performing the model test.

23.2 Type Tests shall necessarily be performed on 17.5 KV Bus Duct and one of the 46 MVA single phase Step Up Transformers as per relevant IEC as stipulated in Chapter-4 and 5 of the Technical Specifications respectively. Prices quoted for these two items of equipment shall, therefore, be inclusive of the cost of performing these Type Tests.

24.0 **Spare Parts and Tools**24.1 **Spare Parts**

24.1.1 All spare parts to be supplied shall be interchangeable with the corresponding parts of all the plant supplied under these Specifications and shall be of the same material and workmanship. They shall be replaceable without cutting or destruction of adjacent components. Before issue of the Taking-Over Certificate the spare parts shall be checked and tested at the Site by the Contractor in presence of the Purchaser.

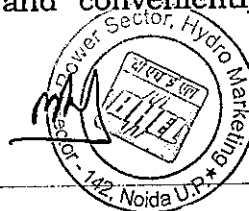
24.1.2 Acceptance of any spare parts will not take place before the Contractor has submitted the complete final detailed list of all spare parts and tools.

24.1.3 All spare parts shall be protected against corrosion and shall be marked with identification labels in the English Language. The identification shall be in accordance with the agreed Plant Identification System.

24.1.4 All spare parts, tools and materials shall be delivered in marked boxes of sufficient sturdy construction to withstand long term storage. The Contractor shall label and conveniently store all



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spare parts in racks provided by him in ready to use manner before handing over to the Purchaser.

24.2 **Mandatory Spare Parts**

24.2.1 At least the quantity of mandatory spare parts required for successful operation and maintenance of the plants and equipment for a period of 5 years shall be included in the Total Tender Price and consequently in the Scope of Works of the Contract.

24.3 **Recommended Spare Parts**

24.3.1 If any additional spare parts are recommended by the Contractor, these shall be stated in quantity and description in the Technical Data Sheets for each item.

24.3.2 Prices for additional recommended spare parts shall not be included in the Total Tender Price for evaluation purpose.

24.4 **Mandatory Tools and Appliances**

24.4.1 Contractors shall supply all mandatory tools & appliances as specified in technical specification. Contractor shall also suggest any addition and deletion in the list specified by the purchaser required for total assembly and disassembly of all parts of the supplied plant and accessories for maintenance of the plant.

24.5 **Recommended Special Tools and Equipments**

24.5.1 The Contractor shall have to furnish the list of recommended special tools and equipments. Prices for recommended special tools & equipments shall not be included in the total tender price.

24.5.2 Foreign bidder shall identify the indigenous source (within the country of operation of the unit) for supply of spares and indicate the same in their offer.

25 **TECHNICAL/DESIGN CO-ORDINATION MEETING**

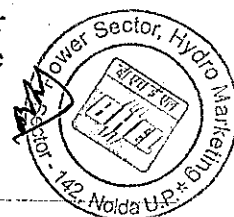
25.2 The Contractor shall be called upon to organise and attend monthly Design/ Technical Co-ordination Meetings(TCMs) with the Employer/Employer's representatives and other Contractors of the Employer during the period of contract. The Contractor shall attend such meetings at his own cost at project site or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.

25.3 The Contractor should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the Contractor shall submit all drawings as per the agreed Engineering Information Submission Schedule. The drawings submitted by the Contractor will be reviewed by the Employer as far as practicable within three (3) weeks from the date of receipt of the drawing. The comments of the Employer shall then be discussed across the table during the above



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Technical Co-ordination Meeting (s) wherein best efforts shall be made by both sides to ensure the approval of the drawing.

- 25.4 The Contractor shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Contractor shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.
- 25.5 Should any drawing remain unapproved for more than six (6) weeks after it's first submission, this shall be brought out in the monthly Engineering Progress Report with reasons thereof.
- 25.6 Any delays arising out of failure by the Contractor to incorporate Employer's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Contractor to alter the Contract completion date.

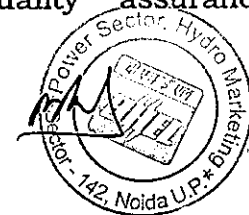
26 DESIGN IMPROVEMENTS

- 26.2 The Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly.
- 26.3 If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.

27 QUALITY ASSURANCE PROGRAMME

- 27.1 The Contractor shall adopt suitable quality assurance programme to ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with IS/ISO-90021. A quality assurance programme of the contractor shall generally cover the following:

- i) His organisation structure for the management and implementation of the proposed quality assurance programme
- ii) Quality System Manual
- iii) Design Control System
- iv) Documentation and Data Control System



- v) Qualification data for Bidder's key Personnel.
- vi) The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
- vii) System for shop manufacturing and site erection controls including process, fabrication and assembly.
- viii) Control of non-conforming items and system for corrective actions and resolution of deviations.
- ix) Inspection and test procedure both for manufacture and field activities.
- x) Control of calibration and testing of measuring testing equipment.
- xi) System for Quality Audits.
- xii) System for identification and appraisal of inspection status.
- xiii) System for authorising release of manufactured product to the Employer.
- xiv) System for handling, storage and delivery.
- xv) System for maintenance of records, and
- xvi) Quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component.

27.2 General Requirements - Quality Assurance

27.2.1 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award.

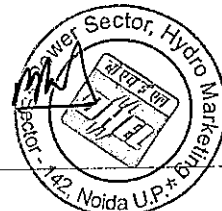
27.2.2 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and

final testing/performance testing. The Quality Plan shall be submitted on electronic media e.g. E-mail in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM.

- 27.2.3 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site.
- 27.2.4 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval.
- 27.2.5 No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to predespatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC).
- 27.2.6 All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties; chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.
- 27.2.7 The contractor shall submit to the Employer Field/Site Welding Schedule for field welding activities. The field/site welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, procedures etc. at least ninety days before schedule start of erection work at site.
- 27.2.8 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer.

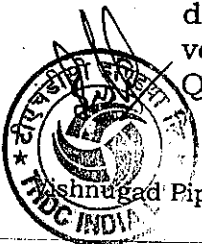


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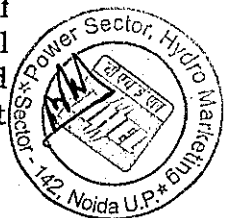
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- 27.2.9 All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.
- 27.2.10 All brazers, welders and welding operators employed on any part of the contract either in Contractor's/sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.
- 27.2.11 Welding procedure qualification & Welder qualification test results shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorised representative.
- 27.2.12 Any other statutory requirements for the equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding.
- 27.2.13 Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.
- 27.2.14 No welding shall be carried out on cast iron components for repair.
- 27.2.15 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
- 27.2.16 The Contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the sub-contractor proposed by the Contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Contractor and finalised with the Employer, shall be subject to Employer's approval. The contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion.
- 27.2.17 For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract.



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between the Contractor and sub-contractor. Within three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the monthly basis by the Contractor .

27.2.18 Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-contractor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.

27.2.19 The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.

27.2.20 Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.

27.2.21 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.

27.2.22 Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.

27.3 QA Documentation Package

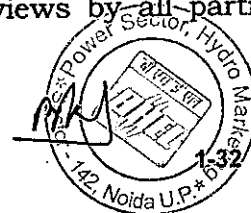
27.3.1 The Contractor shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (□) mark.

27.3.2 Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.

27.3.3 The QA Documentation file shall be progressively completed by the Supplier's sub- supplier to allow regular reviews by all parties during the manufacturing.



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27.3.4 The final quality document will be compiled and issued at the final assembly place of equipment before despatch. However CD-Rom may be issued not later than three weeks.

27.3.5 Typical contents of QA Documentation is as below:-

- i) Quality Plan
- ii) Material mill test reports on components as specified by the specification and approved Quality Plans.
- iii) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.
- iv) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
- v) Heat Treatment Certificate/Record (Time- temperature Chart)
- vi) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure).
- vii) Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points.
- viii) Certificate of Conformance (COC) wherever applicable.
- ix) Material Despatch Clearance Certificates (MDDC)

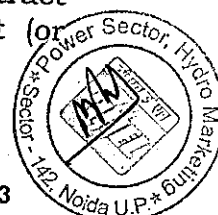
27.3.6 Similarly, the contractor shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.

27.3.7 Before despatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

- i) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.
- ii) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.



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- iii) If a decision is made to despatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the despatch of equipment.

28 Engineer-In -Charge Supervision

- 28.1 To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Engineer-in-charge and without prejudice to the provisions of 'Arbitration' clause in GCC of Part-1: bidding procedures of the Bidding Document, the Contractor shall proceed to comply with the Engineer-in-charge decision.
- 28.2 The work shall be performed under the supervision of the Engineer-in-charge. The scope of the duties of the Engineer-in-charge pursuant to the Contract, will include but not be limited to the following:
- Interpretation of all the terms and conditions of these documents and specifications:
 - Review and interpretation of all the Contractor's drawing, engineering data, etc:
 - Witness or his authorised representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract :
 - Inspect, accept or reject any equipment, material and work under the contract :
 - Issue certificate of acceptance and/or progressive payment and final payment certificates
 - Review and suggest modifications and improvement in completion schedules from time to time, and
 - Supervise Quality Assurance Programme implementation at all stages of the works.

29 Measuring Systems

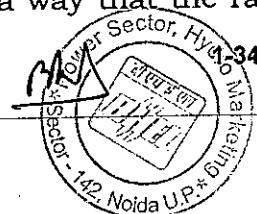
29.1 General

- 29.1.1 Only electric measuring signals of 4 – 20 mA shall be transmitted to the control room. The output signal of transmitters shall be 4 – 20mA and linear over the whole measuring range.

- 29.1.2 The components shall quickly respond to any changes of the measured magnitudes. Measuring ranges of indicators, transducers, etc., shall be selected in such a way that the rated



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value of the measured magnitude covers approx. 75% of the range.

29.1.3 All local instruments shall, as far as practicable, be mounted vibration free to allow good reading. Wherever required, damping elements shall be used.

29.1.4 Corresponding systems shall be grouped together in local panels.

29.1.5 All local indicating instruments and test connections shall be included in the respective plant as integrated parts. The scope of local indicating instruments and test connections shall enable the operator to properly survey the plant, and shall also allow to adequate carry out all acceptance and other tests.

29.1.6 The binary sensors shall be fused separately and supplied with 24V DC.

29.2 Flow Measurements

29.2.1 Flow meters shall be of electromagnetic type with high vacuum and abrasion resistance interior.

29.2.2 One NO and one NC snap action contacts shall be provided for maximum and minimum values. Error limit shall be less than 5% of the measured value.

29.2.3 The design and arrangement of tapping points, piping and valves shall be in accordance with relevant Indian Standards / VDI / VDE 3512.

29.3 Temperature Measurements

29.3.1 All wells for capillary type thermometers, resistance temperature sensors and thermocouples shall be of the weld-in type. Wells for thermometers and temperature sensors of the screw-in type shall be restricted to measuring points for lubrication oil, and to such measuring points where welding is not suitable, e.g., at cast-iron parts. Shop-welded thermometer wells be covered by screw caps for protection during transportation and erection.

29.3.2 Resistance thermometers and thermocouples shall be equipped with waterproof connection heads. Thermometer arrangements shall be such that the connection heads do not become warmer than 80°C, and the measuring inserts are easily exchangeable.

29.3.3 The temperature sensors shall be selected in such a way to minimize the number of different spare inserts.

29.3.4 Resistance temperature detectors shall be standard type platinum, (100 ohm at zero degree centigrade). The wire of resistance shall be wound on ceramic base. The RTD protecting tube shall be of the pipe thread screw-in type.

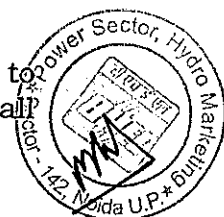
29.3.5 Temperature to be recorded shall be measured by means of resistance thermometers or thermocouples which can directly be connected to the recorders.

29.3.6 The use of dial-type contact thermometers shall be restricted to bearing metal, cooling water and oil temperature measuring. In all

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other cases, thermocouples or resistance thermometers and electric contact modules (monitors) shall be used. Glass thermometers or similar will not be accepted as contact thermometers.

29.4 Transducers

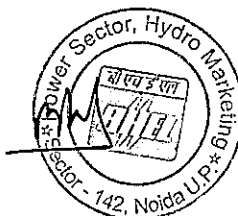
- 29.4.1 The transducers shall be solid- state type with an output signal range of 4-20 mA DC or 1 to 5 V DC, unless otherwise specified.
- 29.4.2 The rms ripple current shall be less than 1 (one) percent within the rated measuring ranges.
- 29.4.3 Each transducer shall be able to operate upto a load impedance ranging between 0 to 500 ohm without adjustment of output. Transducers shall have a minimum adjustment of output current $\pm 5\%$.
- 29.4.4 The transducers and their power supplies shall be designed so that no appreciable deviation in the output current is produced switching or other voltage transients in the supply. The output leads from the transducers to the main terminal block shall be shielded.

29.5 Pressure Measurement

- 29.5.1 Pressure gauges shall be shock and vibration-proof (preferably by filling with glycerine) and shall be equipped with toothed wheels and toothed segments of the machined type. They shall completely be made of stainless steel.
- 29.5.2 Higher than rated pressure shall not deteriorate the pressure gauge or affect its calibration. The pressure gauges shall be equipped with a radial connecting stud, to allow the mounting on a gauge holder.
- 29.5.3 Pressure gauges with potentiometers will not be accepted for use as a pressure transmitter.
- 29.5.4 The error for pressure transmitters shall be limited to $+ 0.5\%$.
- 29.5.5 Pressure gauges and transmitters for inflammable liquids shall have filled systems and the filling liquid shall be separated from the inflammable liquid by means of adequate isolating membranes.
- 29.5.6 Each gauge, pressure switch and transmitter for absolute or differential pressure shall be equipped with a pressure gauge isolating valve including a test connection of the screwed type M20 x 1.5mm so that such device can be removed without any disturbance of the plant operation.
- 29.5.7 Pressure gauges and transmitters for pressure of 10 bar and above, shall not be directly mounted on the pressure tapping point. They shall be mounted apart from the tapping point on gauge holders or gauge boards. Whenever possible, pressure gauges and transmitters shall be group wise combined on racks or consoles.



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- 29.5.8 Pressure gauges for high pressures shall be equipped with a relieve valve for safety reasons in case of leaks (with a rubber reverse flow check).
- 29.5.9 In case of flowing substances, the measuring point shall be selected in locations of undisturbed flow.
- 29.5.10 If the pressure is pulsating, the devices concerned shall be connected via flexible tubes or other pulse-absorbing means.
- 29.5.11 The design and arrangement of tapping points, piping and valves shall be in accordance with relevant Indian Standards / VDI/VDE 3512.
- 29.5.12 The scales shall have a diameter of 150mm with black letters and figures on a white ground. The calibration shall be in kg/cm².
- 29.5.13 The high and low pressure connections of differential pressure gauges shall be marked accordingly.
- 29.5.14 All casings shall be dust proof and watertight and be made of stainless steel.

29.6 Vibration Measurements

- 29.6.1 The vibration probe shall be of Piezoelectric acceleration sensor or proximity type based on either eddy current or magnetic pickup. For reliability, it is always desired that two probes at right angles to each other shall be utilised.
- 29.6.2 The proximity vibration sensor shall be used for measuring the rotating parts vibration/runout. The sensor probe shall be electrically isolated where it is supported.

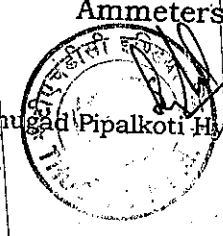
29.7 Level Measurements

The liquid level measurements in reservoirs and tanks with atmospheric pressure shall be made by means of pressure transmitter of mercuryless-type, by displacement-type transmitters or float-disc-transmitters. The errors shall not exceed $\pm 1.0\%$ of the total measuring range. Level switches shall be of packless construction; there shall be a minimum of moving parts.

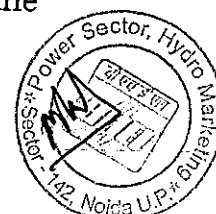
29.8 Electrical Measurement

- 29.8.1 All Electrical instruments shall be of flush mounted design, dust and moisture-proof. AC Ammeters and Voltmeters shall have moving iron system of not less than 1.5 accuracy class for connection to the secondary side of instrument transformers. DC measuring instruments shall have moving coil systems of the same accuracy. Wattmeters shall have electro-dynamic measuring mechanisms or alternatively a moving coil mechanism if fed by transmitters. Wattmeters shall be suitable for unbalanced system.
- 29.8.2 All indicating instruments shall generally withstand without damage a continuous overload of 20 % referred to the rated output value of the corresponding instrument transformers. Ammeters shall not be damaged by fault-currents within the

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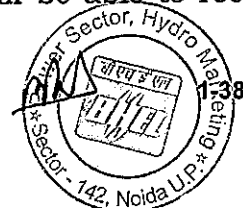


rating and fault duration time of the associated switchgear via the primaries of their corresponding instrument transformers.

- 29.8.3 All instruments and apparatus shall be capable of carrying their full load currents without undue heating. All instrument and apparatus shall be rear connected, and the enclosures shall be earthed. Means shall be provided for zero adjustment of instruments without dismantling.
- 29.8.4 All voltage circuits to instruments shall be protected by fuses in the unearthed phases of the circuit installed as close as practicable to the instrument transformer terminals or where instruments are direct-connected as close as practicable to the main connection. All power factor indicators shall have the star point of their current coils brought out to a separate terminal which shall be connected to the star point of the current transformer secondary windings.
- 29.8.5. When more than one measured value is indicated on the same instrument, a measuring point selector switch shall be provided next to the instrument and shall be engraved with a legend specifying each selected measuring point.
- 29.8.6 All instruments shall be of the flush mounting type and shall be fitted with non-reflecting glass and shall comply in every respect with the requirements of IEC 51. Except for instruments employed for plant performance tests all instruments shall have an accuracy class of 1.5.
- 29.8.7 Scales shall be arranged in such a way that the normal working indication is between 50-75% of full scale reading permitting an accurate reading. CT connected Ammeters provided for indication of motor currents shall be provided with suppressed overload scales of 2 times full scale. The dials of such Ammeters shall include a red mark to indicate the full load current of the motor.
- 29.8.8 Where directly connected Ammeters are provided for indication of motor currents they shall be supplied with overload scales indicating up to six times full load current. The dials of such Ammeters shall include a red mark to indicate the full load current of the motor.
- 29.8.9 Instrument scales shall be submitted for approval by the Purchaser. All instruments mounted on the same panel shall be of same style and appearance.
- 29.8.10 Transmitter connected Ammeters shall have 90° or 240° circular scales calibrated 0-120%. The rated motor current shall correspond to 100% scale indication.
- 29.8.11 Energy meters shall be of the induction disc type with limits of error according to IEC 170. The casings shall be dust and moisture-proof and shall fit into the boards to permit reading without opening the corresponding front door. Disc and cyclometers of the drum-type shall be clearly visible through a window in the casing and the cyclometer shall be able to record



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for a minimum of 2.5 hours. Meters shall be suitable for unbalanced systems.

29.9 Digital type Instruments

The indicative element for each digital indicator shall be seven segment LED illumination type. The number of digits of each digital indicator shall be selectable to sent the required indication. The watt and the var indicators for the circuits where direction of power flow may be changed, shall be provided with "+" and "-" signs.

29.10 Position Measurements

Position transmitters of the potentiometer type will not be accepted. Inductive or capacitive type shall be provided.

29.11 Contact Devices

Contacts of level switches, pressure switches, limit switches, and of all other devices shall be of the snap action type (SPDT). Contact devices for interlocking systems shall be separate, i.e., contact devices serving commonly for interlocking and other purposes will not be accepted.

30.0 TRANSPORT AND INSTALLATION

30.1 The bidder is advised to have a total study of all aspects of transportation of equipments to site and should make schedule of transportation in accordance with the prevailing conditions at site. The bidder shall specifically understand that the Purchaser will do the general co-ordination of storage and erection works as well as civil engineering works of power house. An appropriate period for transportation shall be considered accordingly.

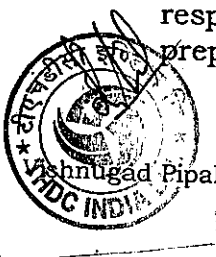
30.2 The Purchaser will do the general co-ordination of storage and erection work as well as the civil engineering work under the different packages on site.

30.3 The delivery dates, transportation and erection periods and for all other associated activities indicated in the Contract Documents shall be strictly adhered to. Changes, which are unavoidable or necessary, will be regulated in accordance with the stipulations laid down in the General Conditions of Contract.

30.4 From the time of manufacturing until commissioning all parts of the plant shall be protected and insured at the Contractor's expense against loss & damage of any kind. Parts, which are damaged during transport, storage, erection or trial operation, shall be replaced at the Contractor's expense.

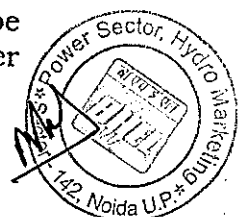
30.5 Packing and Marking

30.5.1 The Contractor shall prepare all plant, devices and materials for shipment to protect them from damage in transit, and shall be responsible for and make good all damages due to improper preparations, loading or shipment.



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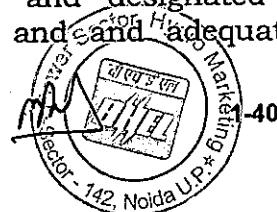
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- 30.5.2 After the workshop assembly and prior to dismantling for shipment to the Site, all items of machinery and plant shall be carefully marked to facilitate site erection. Wherever applicable, these markings shall be punched or painted so that are clearly visible.
- 30.5.3 Dismantling shall be done into convenient sections, so that the weights and sizes are suitable for transport to Site and for handling on the Site under the special conditions of the Project.
- 30.5.4 All individual pieces shall be marked with the correct designation shown on the Contractor's detailed drawings and other documents (packing, lists, spare part lists, in Operating and Maintenance Instructions, etc.).
- 30.5.5 Each piece, separately shipped, or smaller parts packed within the same case or box, shall be legibly, marked to show the unit to which it is a part and match-marked to show its relative position in the unit.
- 30.5.6 Unit marks and match-marks shall be done preferably by punching the marks into the metal before painting, galvanizing, etc., and shall be clearly legible after painting, galvanizing etc. In labelling, the Contractor shall endeavour to use as few designations as possible, and each part of identical size and detail shall have the same designation, regardless of its final position in the plant.
- 30.5.7 All parts of the plant shall be packed at the place of manufacture; the packing shall be suitable for shipment by sea and for all special requirements of the transportation to Site. Where necessary, double packing shall be used in order to prevent damage and corrosion during intermediate storage.
- 30.5.8 All identical members shall be packed together, if reasonably possible, in a form convenient for shipment and handling.
- 30.5.9 Small items shall be packed in boxes and large items shall be protected where necessary, by timber, straw and sacking. Drums shall be used for electric cables, steel ropes, steel wire and similar materials. All bolts, nuts, washers, etc., shall be packed in containers. Each container shall include only bolts, nuts or washers of identical size.
- 30.5.10 All parts shall be suitable protected against corrosion, water, sand, heat, atmospheric conditions, shocks, impact, vibrations, etc.
- 30.5.11 All electrical parts shall be carefully protected from damage by sand, moisture, heat or humid atmospheric conditions by packing them in high pressure polyethylene foil. Where parts may be affected by vibration, they shall be carefully protected and packed to ensure that no damage will occur while they are being transported and handled.
- 30.5.12 Spare parts shall be packed separately and designated as specified and shall be delivered properly and adequately



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packed for several years' storage. All packing costs shall be included in the scope of Work.

30.6 Shipping Marks

The Contractor shall mark all containers with the implementing document number pertinent to the shipment. Each shipping container shall also be clearly marked on at least two sides as follows:

Consignee:

Contract No.:

Port of destination:

Item number (if applicable)
Package number, in sequence
and quantity per package:

Description of Works:

Net and gross weight, volume, Dimensions

30.7 Packing Lists

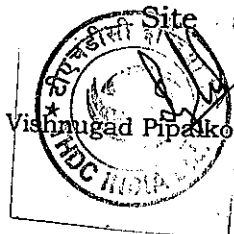
The Contractor shall provide the Purchaser with one (1) original and two (2) copies of all shipping documents and relevant packing lists of each shipment of equipment items after the same has been shipped. One copy (1) of the packing list shall be sent to the Purchaser's Representative. All packing lists shall contain the name of the Contractor or supplier and shall show the complete markings on each packed box or crate that has been shipped. Separate packing lists shall be prepared for each and all shipments made. One copy of the packing list shall be placed inside each box or crate, and one copy inserted in a weatherproof envelope affixed to the outside of each box or crate.

30.8 Equipment Handling and Storage

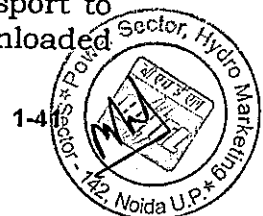
30.8.1 All equipment shall be handled very carefully to prevent any damage or loss. Wires, chains, ropes slings etc. used for handling of the equipments shall be appropriately protected by sleeves or other means to prevent damage to the equipment.

30.8.2 The equipment stored shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the storage shall be moved to the actual location at appropriate time so as to minimize risk of damage of such equipment at site.

30.8.3 The Contractor shall provide means for all unloading and reloading for all consignments of plant, both during transport to Site and on the Site. Consignments shall be unloaded



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immediately on arrival at Site. The Contractor is required to take the necessary steps in order to provide the carriage, special supporting structures for heavy loads, etc.

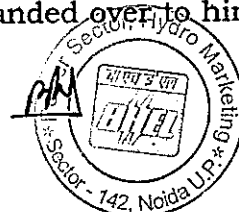
- 30.8.4 All large parts of the plant shall be brought, as far as possible and practicable, directly to their final place of erection.

30.9 Storage Area and Warehouses

- 30.9.1 The Purchaser will designate areas where the Contractor may store parts of the plant. The Contractor shall, at his own expense, render such areas suitable for the respective purposes.
- 30.9.2 The warehouses shall be weatherproof, with good ventilation and solid floors. The floors of the warehouses and storage areas shall be designed to carry the loads imposed on them by the stored parts. The following parts shall be stored inside enclosed warehouses:
- i) Electrical parts with electrical devices attached, electric motors and excitation equipment
 - ii) Instruments, welding material and equipment, bolts, pins, packing, tools, insulation materials A
 - iii) All small parts and parts of the plant which already have been finally painted.
- 30.9.3 All electrical panels, control gears, motors and such other devices shall be properly dried by heating before they are put into storage. If panels equipped with anti-condensation heaters will be stored over longer period of time (more than one month), the Contractor shall assure that the heaters are energised.
- 30.9.4 Motor bearing slip-rings, commutators and other exposed parts shall be protected against moisture ingress and corrosion during storage and motors shall be periodically rotated to prevent corrosion due to prolonged storage.
- 30.9.5 If large parts are stored in the open air, they shall be provided with weather resistant and fire-resistant covers. Electrical parts, which are not packed in heavy-duty polyethylene foil and those so packed, but whose packing has been damaged, shall be kept in suitable place from the moment of storage to the moment of installation.
- 30.9.6 All insulation materials which will be taken from the warehouse for installation and which are stored temporarily in the powerhouse shall be protected from weather or humidity.
- 30.9.7 The consumable and other supplies likely to deteriorate due to storage must be thoroughly protected and stored in a suitable manner to prevent damage or deterioration in quality by storage
- 30.9.8 The Contractor shall ensure that all the packing materials, and protection devices used for the equipment during transit and storage are removed before the equipment are installed. The packing materials and protection devices shall remain the property of the Purchaser and shall be handed over to him by the



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Contractor after completion of the work. In case, the Contractor fails to return the packing materials and protection devices, the Purchaser shall have the discretion to deduct from the Contract price at a reasonable amount on this account.

30.9.9 If the materials belonging to the Contractor are stored in areas other than those earmarked for him, the Purchaser will have the right to get it moved to the areas earmarked for the Contractor at the Contractor's cost.

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

30.10 Preparation of Site Installation Works

30.10.1 Prior to commencement of installation, the Contractor shall closely inspect the Site and all the foundations and other structures on which parts of the plant supplied under this Contract will be installed; he shall check that the foundations conform to the installation drawings.

30.10.2 The result of this check shall be reported to the Purchaser in due time to allow any errors to be corrected before the commencement of erection. All parts of the plant shall be cleaned carefully of all contamination such as dust, sand, rust, mill scale and other dirt prior to installation.

30.11 Reference Points

30.11.1 The Purchaser will provide major centre lines and datum levels only. The Contractor shall be responsible for transferring those required to carry out the Works. The Contractor shall employ a competent surveyor for setting-out of all datum lines including the constant checking and maintenance of the setting-out until the completion of his works.

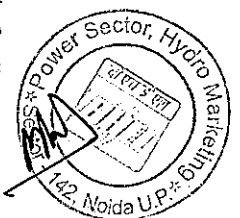
30.11.2 The Contractor shall provide all necessary pegs, profiled templates and centre lines and shall establish all such permanent markings and recovery marks as may be required by the Purchaser for checking the Contractor's setting-out. The Contractor shall be responsible for rectifying, at his own cost, all work rejected by the Purchaser due to errors in setting-out.

30.11.3 All bench marks, kerb marks, pegs and signals on the surface, alignment pins and the like put in by the Purchaser for the purpose of checking the Contractor's work or as permanent survey marks will be under the care of the Contractor during the period of the Contract. He shall, at his own expense, take all proper and reasonable care and precautions to preserve and maintain them in their true position where such marks are within or adjacent to his work area. In the event of their being disturbed or obliterated by any cause whatsoever, they may, if so determined by the Purchaser, be replaced by the Purchaser at the Contractor's expense.



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44 30.11.4 The Contractor shall be responsible for the true and proper staking-out of the works and levels of reference given by the Purchaser in writing, for the correctness of the positions, levels, dimensions and alignment of all parts of the works and for the provision of all necessary instruments, appliances and labour in connection with this.

30.11.5 The checking of any staking-out or of any line or level by the Purchaser or the Purchaser's Representative shall not in any way relieve the Contractor of his responsibility for its correctness.

30.12 Installation Work

30.12.1 All transportation and handling of the plant from the place of storage to the place of installation shall be carried out by the Contractor. He shall also provide all hoisting equipment, staging and scaffolding, winches and wire ropes, slings, tackles and all other appliances and temporary materials. The erection staging and scaffolding shall be provided with coverings and barriers and shall guarantee safe working conditions.

30.12.2 The Contractor shall comply with all applicable and approved safety regulations while carrying out the works at Site and with all reasonable requirements of the Purchaser. This stipulation shall in no way release the Contractor from any obligation concerning his liability for accidents and damage. He shall be responsible for adequate protection of persons, plant and materials against injuries and damages resulting from his operations.

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

30.12.4 The Contractor shall be responsible that the installation of all plants is properly executed to the correct lines and levels and in accordance with the manufacturer's instructions and the Contract requirements.

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

30.12.6 Setting of parts to be aligned shall be performed by means of fine measuring instruments. All erection clearances and settings shall be given to the Purchaser. After alignment, the parts shall be held firmly in position by means of set pins, fitted bolts, etc.

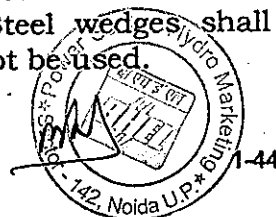
30.13 Embedded Parts

30.13.1 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.

30.13.2 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 secure adequately. Steel wedges shall be secured by welding. Wooden wedges shall not be used.



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- 30.13.3 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 Purchaser for checking and approval before items are built-in to the works.

30.14 Temporary Bracing

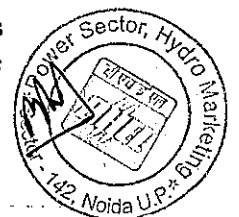
- 30.14.1 The Contractor shall provide all necessary anchors and braces to ensure the alignment and stability of the parts to be installed. All temporary anchors and bracings shall take care of all dead load, wind load, ice load, seismic and erection stresses, e.g., during concreting, and shall remain in place until they can be removed without endangering the stability of the plant.
- 30.14.2 Temporary bracing and attachments shall be fixed and removed in such a way as to prevent damage occurring to the base metal to which they are attached. Projecting welds remaining after this operation shall be ground flush. Tears in the base metal shall be filled with weld and ground flush. After completion of work, the surface shall be restored to proper condition by grinding and repainting.
- 30.14.3 Welding, torch-cutting and drilling work on the plant to be erected shall only be carried out with the approval of the Purchaser.

30.15 Workmanship

- 30.15.1 Special care shall be taken not to damage surfaces of galvanized or specially treated plant 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.
- 30.15.2 Glass parts of other parts which can easily be damaged shall be provided with suitable protective sheaths or coverings during installation.
- 30.15.3 Machined or bare metal surfaces that are not painted shall be protected during transportation, storage and erection by a suitable anti-corrosion film.
- 30.15.4 All portable power tools shall preferably be operated pneumatically.
- 30.15.5 Special tools which are supplied for maintenance and repair can be used for installation. They are to be handed over at the end of the installation work in good condition in accordance with the Purchaser's instruction.
- 30.15.6 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 be restored.

30.16 Modifications, Rectifications and Re-Erection

- 30.16.1 If the dismantling, modifications, rectification, addition etc. is necessitated due to any mismatch / discrepancy in the



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fabrication drawing prepared by the Contractor or in fabrication, the Contractor shall be held responsible for the same despite the fact that such drawing might have been approved by the Purchaser. In such cases, nothing extra shall be payable to the Contractor towards carrying out such modification, rectification, addition, dismantling testing, transportation and any other allied activity.

- 30.16.2 In case, it is found that certain erection marks as already detailed and approved in fabrication drawings require addition, alternation and modification, the same shall be done on the written orders of the Purchaser or his authorised representative.
- 30.16.3 The work of re-erection include carriage of modified erection marked members from fabrication shop to erection site, lifting of the same to the required position, aligning, erection in position inclusive of bolts and touch up pointing etc. complete to the satisfaction of the Purchaser.
- 30.16.4 The quoted price shall include all these operation.

30.17 Foundation Bolts

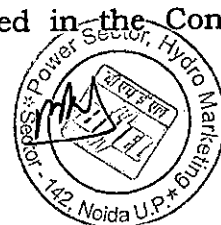
- 30.17.1 Foundation bolts for bus structure and elsewhere shall be embedded in first stage concrete while foundations cast. The bolts may be provided in pipe sleeves permitting adjustments in the proper alignment of these bolts to match holes in the structure basis. The final adjustment of these bolts and their grouting and provision of shiner for correct erection of structure is to be included in the unit rate of items of structural steel.
- 30.17.2 The Contractor shall be responsible for the correct alignment and levelling of all steel works on Site to ensure that the columns/towers and structures are plumb.
- 30.17.3 Before erection of columns/towers/structures on the foundations, the top surface of base concrete shall be thoroughly cleaned with wire brushes and by chipping to remove all laitance and loose material and shall be chipped with chisel to ensure proper bond between the ground and foundation concrete. The Contractor shall also be responsible for bringing the top of concrete to the desired level by chipping. In case foundation as cast in lower than the desired level. The Contractor shall make up the difference by providing additional pack plates and shims without any extra payment for any such work or materials.
- 30.17.4 No steel structures shall be put on foundation unless such foundations have been certified fit for erection of steel by the Purchaser. Adequate number of air release holes and inspection holes shall provided in the base plate.
- 30.17.5 Foundation bolts for the structures shall be supplied by the Contractor.

INSPECTION AND TESTS

In addition to the provisions established in the Conditions of



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Contract regarding general procedure of inspections and tests, terms and definitions, and time schedules for inspections and tests the following stipulations shall apply.

- 31.2 Purchaser reserves the right to ask for the valid calibration certificate for any instrument to be used for testing or may get the instrument tested by any independent agency.

31.3 Type Tests / Routine Tests / Acceptance Tests / Site Tests

- 31.3.1 For the specified type tests certificates for the same equipment type, not older than ten years from the date of signing the Contract, shall be submitted for approval by the Purchaser. In case that the test certificates are older than ten years the Contractor shall carry out the specified type tests at his own costs.

- 31.3.2 Contractor shall have to do all the routine tests, acceptance tests & site tests required as per technical specification & Indian Standards / International Standards.

- 31.3.3 Contractor shall have the access to the required facilities as stated in the relevant standards to carryout the tests on the various equipments.

- 31.3.4 In case, contractor does not have the facility to carryout any of the test and intends to carryout the same at some other agency those testing agencies shall be got approved by the purchaser.

31.4 Workshop Inspections and Tests

- 31.4.1 As far as practicable, quality of materials, workmanship and performance of all items of the work and plant to be furnished under this Contract shall be inspected at the places of manufacture.

- 31.4.2 When placing orders for material and plant with Sub-suppliers, the Contractor shall send unpriced copies of such orders in triplicate to the Purchaser.

- 31.4.3 Arrangements shall be made for expediting the shop inspection by having all shop assemblies or pieces covering a single shipment ready at one time. Any painting work as well as transport to the Site of the plant shall not be started before the approval of the Purchaser has been obtained.

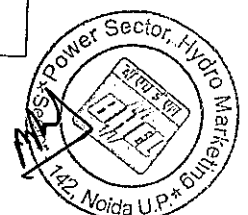
31.3 Material Tests

- 31.5.1 Unless otherwise specified, the quality of materials shall be verified generally by:

chemical analysis	
mechanical tests	(yield point, tensile strength, elongations, notch impact strength, etc.)

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welding tests	(welding procedure, welding material, welding tensile strength, welding bend test, welding reversed bend test, etc.)
non-destructive tests	(x-rays, ultrasonic, magnaflux, liquid penetration inspection, etc.)
electrical tests	(voltage, losses, tan delta, insulation, magnetic properties, etc.).

31.5.2 Certified mill test reports of plates will be acceptable when these comply with the requirement for "Reports of Inspections and Tests" as stated in the Special Conditions. Test specimen and samples for analysis shall be plainly marked to indicate the materials they represent.

31.5.3 Castings and forgings shall be tested in the rough state in order to detect flaws in good time thus avoiding delays. Magnetic particle inspection of important castings shall cover the whole surface of the casting. After partial machining further tests can be conducted.

31.5.4 Load tests on crane hooks, steel wire ropes, chains, etc. shall be considered as material tests.

31.6 Checking of Dimensions

31.6.1 The dimensions, especially clearances and fits, (ISO 286) which are essential for operation and efficiency shall be carefully checked in an approved manner, as for example:

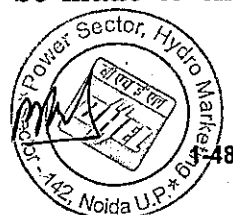
- i) runout and roundness tolerances of shafts. Rotors, pistons, etc., to be measured on single parts as well as (wherever possible) on the assembled components
- ii) fits and clearances of bearings, runners, rotors, servomotor pistons, valves, guiding, distributing and actual actuating elements, etc.
- iii) accuracy, surface roughness and shape of sliding and guiding surfaces of seals, bearings, water passages in hydraulic machinery, valves, etc.
- iv) profiles of turbine runners, pump impellers, etc. to be checked by means of templates
- v) dimensions of couplings or connections for assembly with other deliveries from the Contractor, Sub-contractors or other contractors.

31.7 Shop Assembly

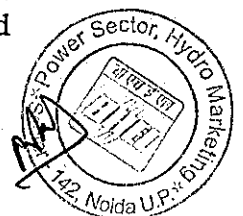
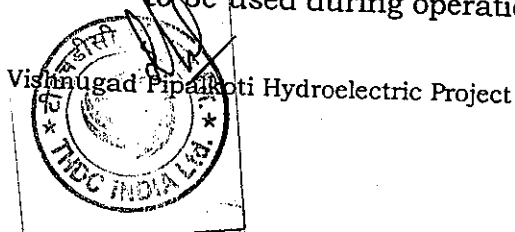
31.7.1 In addition to the quality and production control tests, the following shop assembly work and tests shall be made to check measurements, fitting and functioning.



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- 31.7.2 Plant to be furnished shall be shop assembled to a status sufficient to prove that the design and workmanship have been executed in accordance with the Specifications, that the delivery is complete, and that no work remains to be done at Site which reasonably can or should be done in the shop.
- 31.7.3 Where applicable, each item of the plant shall be assembled completely prior to painting.
- 31.7.4 Field joints shall be temporarily connected.
- 31.7.5 All parts shall be properly match marked, identified and doweled where practicable, to facilitate correct and quick field assembly and alignment. Wherever necessary, suitable dowels shall be provided for insertion after field assembly and drilling. The holes for any fitted bolt shall be accurately reamed.
- 31.7.6 During shop assembly all instruments, control devices and piping shall be fitted.
- 31.7.7 If the corrections cannot be carried out in accordance with the terms mentioned above, the components concerned will be rejected. The decision on possible subsequent corrections is reserved exclusively to the Purchaser. Faulty parts or plant shall by no means be delivered.
- 31.7.8 The assembled parts shall subsequently be subjected to tests as per applicable standards of required by the Purchaser.
- 31.8 Pressure and Leakage Tests**
- 31.8.1 All parts subject to internal or external pressure or containing any liquids of gases temporarily or permanently during operation shall be tested prior to painting. As far as practicable, these tests shall be done in the shop but can be repeated at Site.
- 31.8.2 Parts exposed during operation to hydraulic pressure, to gas pressure or to any liquid without pressure, shall be treated distinctively.
- 31.8.3 In addition to the Specifications, the applicable and approved standards and official regulations shall be observed. If any liquid is used for the test that may cause corrosion, all plant and piping shall be thoroughly cleaned immediately after the test.
- 31.8.4 As far as practicable and required, the influences of temperatures and temperature differences to which the part will be exposed during operation shall be considered in the execution of the tests.
- 31.8.5 Leaks and defects can be repaired if permitted by the applicable standard and approved by the Purchaser. If defects are found, the Purchaser may reject the defective parts, or permit welding repairs with stress relieving, radiographic examination and additional pressure tests.
- I) Parts Exposed to Hydraulic Pressure**
- 31.8.6 Unless otherwise specified or required, the following shall apply: the hydraulic pressure tests shall be carried out using the liquid to be used during operation or a liquid with less viscosity.



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- 31.8.7 The hydraulic test pressure shall be 1.5 times the maximum operating pressure and shall be maintained for a period of two hours or longer if required by the applicable standards. Afterwards the test pressure shall be reduced to the operating pressure.
- 31.8.8 The welded seams of large parts which are not subjected to any heat treatment during or after welding, shall be rapped with a 500 g hammer during the pressure decrease or treated other wise to obtain the required effect of stress relief.
- 31.8.9 Finally, the test pressure mentioned above shall be maintained for ten (10) minutes. Leakages appearing at seals, joints, etc. shall be measured and stated in the test report, together with the relevant pressures.

II) Parts Exposed to Liquids without Over-Pressure

- 31.8.10 Parts which shall not be closed and which are exposed to only small pressures of any liquid during operation e.g. bearing housings, oil containers, etc. shall be subjected to a tightness test with a suitable liquid of low viscosity. The testing-period shall not be less than 10 hours, unless otherwise agreed.

31.8.1 Functional Tests

- 31.9.1 Functional tests shall be defined as tests of the function of assemblies, subassemblies or parts of the plant under no load conditions. Functional tests shall be performed on all plant prior to the execution of operational tests.

31.9.2 Operational Tests

As far as practicable operational test shall be carried out on all plant, simulating operating conditions.

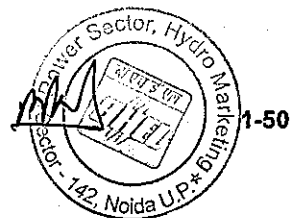
- 31.9.2.1 Parts to be delivered by sub-suppliers shall be tested either at the premises of the sub-supplier or of the Contractor, as agreed by the Purchaser.
- 31.9.2.2 Before testing the Contractor shall submit a notice containing full information on the tests with detailed tables or graphs on the latest edition of the characteristic values of the plant to be tested and on the test facilities and equipment.
- 31.9.2.3 Testing of the electrical plant shall be performed in accordance with applicable Standards; they shall include but not be limited to tests for heating, loading, overloading, losses.
- 31.9.2.4 Operational tests of lifting equipment and other machinery shall include tests under nominal load and 125% of nominal load unless otherwise specified.

31.9.3 Model Tests

Model tests for certain parts of the work or plant shall be carried out as specified.



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31.9.4 Test Reports

Contractor shall have to furnish all the test reports of tests performed on materials, equipments & plants etc. during various stages such as manufacturing, shop assembly etc.

31.9.5 Site Inspection and Tests

31.9.5.1 During erection, commissioning and Test Service Period operation the Contractor shall perform at suitable interval all inspections and tests in the presence of the Purchaser in order to prove the orderly execution of the works in accordance with the Contract.

31.9.5.2 Unless otherwise specified, all costs for testing at Site and of the works and charges associated with it shall be born by the Contractor. This includes the measuring devices, properly calibrated, and any pertinent accessories, which shall be made available by the Contractor for the entire duration of the tests. The Contractor shall delegate his experts to perform the tests at site.

31.9.5.3 For the procedure of inspections and test at Site, notice to the Purchaser, reports, commissioning trial runs and acceptance tests refer to General Conditions.

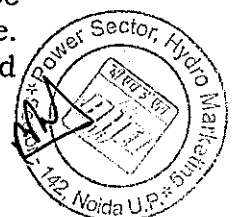
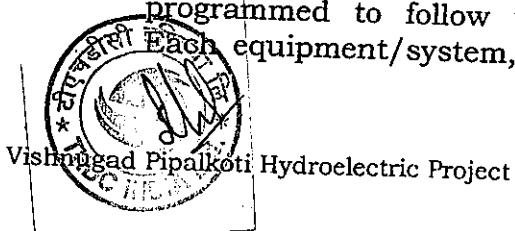
32 PRE-COMMISSIONING AND COMMISSIONING FACILITIES

32.1 As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Employer and the Contractor for correctness of and completeness of facility or part thereof and acceptability for initial pre-commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Contractor's quality assurance programme as well as those included elsewhere in the Technical Specifications.

32.2 The Contractor's pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall be commenced during which period the complete facilities, equipments shall be operated integral with sub-systems and supporting equipment as a complete plant.

32.3 The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period.

32.4 The check outs during the pre - commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and



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turned over to Employer's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed schedule to be agreed by Employer.

32.5 The Contractor during initial operation and performance testing shall conduct vibration testing to determine the 'base line' of performance of all plant rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable.

32.6 Contractor shall furnish the commissioning organisation chart for review & acceptance of employer at least eighteen months prior to the schedule date of synchronisation.

32.7 Initial Operation

32.7.1 Subsequent to completion of all pre-commissioning activities/ tests and as a part of commissioning the complete facilities shall be put on 'Initial Operation' during which period all necessary adjustments shall be made while operating over the full load range enabling the facilities to be made ready for the Guarantee Tests.

32.7.2 The 'Initial Operation' of the complete facility as an integral unit shall be conducted for 720 continuous hours. During the period of initial operation of 720 hours, the unit shall operate continuously at full rated load for a period not less than 72 hours.

32.7.3 The Initial Operation shall be considered successful, provided that each item/ part of the facility can operate continuously at the specified operating characteristics, for the period of Initial Operation with all operating parameters within the specified limits and at or near the predicted performance of the equipment/ facility.

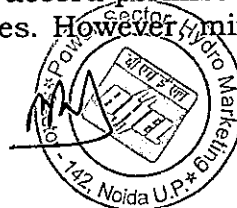
32.7.4 The Contractor shall intimate the Employer about the commencement of initial operation and shall furnish adequate notice to the Employer in this respect.

32.7.5 Any loss of generation due to constraints attributable to the Employer shall be construed as Deemed Generation.

32.7.6 An Initial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Initial Operation shall be prepared by the Contractor. This report, besides recording the details of the various observations during initial operation shall also include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Initial Operation. Based on the observations, necessary modifications/repairs to the plant shall be carried out by the Contractor to the full satisfaction of the Employer to enable the latter to accord permission to carry out the Guarantee tests on the facilities. However minor defects



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which do not endanger the safe operation of the equipment, shall not be considered as reasons for withholding the aforesaid permission.

32.8 Guarantee Tests

- 32.8.1 The final test as to prove the Guarantees shall be conducted at Site by the Contractor in presence of the Employer. The contractor's Commissioning, start-up and initial operation shall make the unit ready to conduct such test.
- 32.8.2 These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the performance guarantees.
- 32.8.3 For performance/ demonstration tests instrumentations, of accuracy class, to the approval of the Employer shall be used. The numbers and location of the instruments shall be as per the specified test codes.
- 32.8.4 Any special equipment, tools and tackles required for the successful completion of the Guarantee Tests shall be provided by the Contractor, free of cost.
- 32.8.5 The Guarantee tests and specific tests to be conducted on equipments have been brought out in detail in the technical specification of each equipment.

33 Taking Over

Upon successful completion of Initial Operations and all the tests conducted to the Employer's satisfaction, the Employer shall issue to the Contractor a Taking over Certificate as a proof of the final acceptance of the equipment. Such certificate shall not unreasonably be withheld nor will the Employer delay the issuance thereof, on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the Contractor of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.

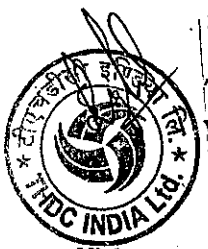
34 DEPUTATION OF EMPLOYER'S ENGINEERS FOR INSPECTION, WITNESSING OF TESTS AND TRAINING FOR THE EQUIPMENT SUPPLIED FROM ABROAD.

- 34.1 Purchaser will depute a team of its own engineers & consultants for Inspection, witnessing of tests, training of various important components of the equipment supplied from abroad.

TRAINING

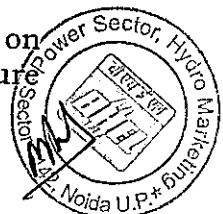
i) Planning, Design and Engineering (Transfer of Knowledge)

The Contractor shall arrange to provide on the job training on various aspects of Design, Analysis, construction, manufacture



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etc. for Employer's personnel up to 60 Man-months (30 Man-months for Electro-mechanical and 30 Man-months for Civil).

The Training courses for all disciplines (Civil, Electro-mechanical & HM) shall be organized in the countries of the manufacturers of Electromechanical equipments and also where similar plants are under operation.

This training shall include but not limited to on the job training in planning, designing, computation analysis of stability and structural strength of various underground structures, analysis for Surges / Transients; Design, Analysis of EM and HM equipments viz. Turbine/Pump, Governor, Spherical Valve, Butterfly Valve, Generator/Motor, Excitation System, Generator Transformer, CCS and SCADA, Protection System etc., Construction Management, Model Testing, pressure testing, nondestructive and destructive testing, visits to the laboratories of the research centres as well as similar Projects and Operational Installations.

The Contractor shall provide at his own cost to the Employer's personnel internal transportation, office rooms, interpreter services, assistance in arranging accommodation but excluding any subsistence allowance.

The program for training the Employer's personnel shall be subject to mutual agreement between the Employer and the Contractor within a three-month period of Effective date of the Contract or date of start. The contractor shall submit in due time to the Employer for approval the programme for training the Employer's personnel.

The programme for training the Employer's personnel shall be corrected or modified on agreement between the Employer and the Contractor.

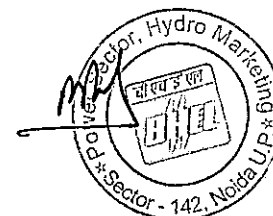
ii). Operation and Maintenance:

The contractor shall arrange to provide training on operation & Maintenance for Employer Personnel for 32 (thirty two) man-months on E/M Equipments viz. Turbine / Pump, Governor, Spherical Valve, Butterfly valve, Generator / Motor, Excitation System, Generator Transformer, CCS & SCADA and Protection system. Breakup of Equipment wise training and batches to be given by the Bidder limited to training for 32 (Thirty Two) man - months in all, matching with the recommended Organization Chart and elaborate plan for training of Employer's Personnel on Operation and Maintenance of the Station subsequent to Commissioning.

The Contractor shall provide at his own cost to the Employer's personnel internal transportation, office rooms, interpreter services, assistance in arranging accommodation but excluding any subsistence allowance.



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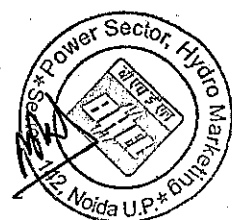
35 . TRAINING OF EMPLOYER'S PERSONNEL

- 35.1** In addition to the requirements given in Section General Condition of contract (GCC), regarding training of Employer's personnel, the following shall also apply.
- 35.2** The Contractor shall provide suitable instructors, training material and facilities (instruments, apparatus, simulators, documents, drawings, protective clothing, rooms, office supplies, etc.) for the Personnel made available by the Employer for training.
- 35.3** One month before the training start, the Employer will send the list of the trainees and any comments on the training program proposed by the Contractor. This program shall be adapted to the design and nature of the Works, and the needs of trainees. Trainees shall be suitably trained in the various aspects of design, manufacture, installation/erection, operation and maintenance, relevant to the training, of works similar to the Works
- 35.4** The Contractor shall supervise and provide direction to, and be liable for the acts or omissions, other than negligent or wilful misconduct of such personnel, of the Employer's trainees.
- 35.5** The Contractor shall provide the training described hereafter in accordance with any further specific requirements stated in the Employer's Requirements.
- 35.6** The Contractor shall assist the Employer in obtaining any visas and other formalities for entering or leaving the territory on which the training is being provided.
- 35.7** The Contractor shall bear responsibility for ensuring the safety of the trainees during their stay in the country of the training. On their part, the trainees shall comply with the laws, regulations and customs of the country in which training is being held.
- 35.8** In the event of illness or accident, the Contractor shall take all steps to provide the trainees with the appropriate medical care.
- 35.9** The Bidder shall provide training to Employer's personnel to meet operational and maintenance requirements of various Systems/equipments supplied under this package.
- 35.10** The scope of service under training of Employer's engineers shall include a training module covering the following :
- 35.11 Training During Engineering/ Manufacturing Phase**
- 35.11.1** This shall cover all disciplines viz, Mechanical, Electrical, C&I & QA etc. and shall include all the related areas like Design familiarisation, training on product design features and product design software of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing, erection, welding etc. The training in areas of



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Operation and Maintenance shall take place preferably during end of manufacture/ tests.

35.12 Training During the Erection / Installation / Site Work

- 35.12.1 Independently from the supervision and inspection functions of the Employer's Representative, the Contractor shall authorise the Employer's Personnel to follow the erection / installation / site work at his site.
- 35.12.2 The Employer's Start-up Personnel shall take no part in the equipment erection and/or installation operations, which shall be exclusively carried out by the Contractor and under his entire responsibility.
- 35.12.3 This on site training shall cover each phase of erection / installation / site work and shall be of sufficient duration.
- 35.12.4 The Contractor shall supply the information or measurements concerning the erection requested by the Employer's Representative or/and by the Employer's personnel.

35.13 Training during the Tests on Completion phase, Operation & Maintenance

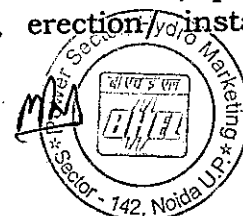
- 35.13.1 The scope of service under training of Customer's engineers shall necessarily include, training of upto twelve (12) Employer's personnel for the power plant in the areas of Operation & Maintenance. The Contractor shall provide on-the-job training in the operation and maintenance of the Works to the Employer's Operating Personnel. Such training shall start at least 30 days prior to commencement of Tests on Completion and continue until Taking Over. Its scope and quality shall be such so that the operation and maintenance phase of the project can be carried out to ensure sustained guaranteed performance of the equal availability of the units as offered. The training should provide the trainees with comprehensive understanding of all operational and maintenance aspects of the Works. Such training shall also include safety and environmental protection aspects applicable to the Works.
- 35.13.2 Exact details, extent of training and the training schedule shall be finalised based on the Bidder's proposal.
- 35.13.3 In all the above cases, whenever the training of Employer's personnel is arranged at the works of the manufacturers, it shall be noted that the lodging and boarding of the Employer's personnel shall be Bidder's scope. The Bidder shall make all necessary arrangements towards the same.

36 SYSTEM DOCUMENTATION

- 36.1 The Bidder shall provide drawings, system overview & description, hardware/ software details, technical literature, functional & hardware schemes, bill of material, parts list, interconnection diagrams, data sheets, erection/installation/



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commissioning procedures, instruction/ operating manuals, etc. for each system / sub-systems/ equipment supplied under this package. The documentation shall include complete details of the systems/ sub-systems/ equipment to enable review by Employer during detailed engineering stage and to provide information to plant personnel for operation & Maintenance (including quick diagnostics & trouble shooting) of these systems/ sub-systems/ equipment at site.

- 36.2 The exact format, submission schedule and contents of various documents shall be as finalised during detailed engineering stage.

37 REGULATION OF LOCAL AUTHORITIES AND STATUTES

- 37.1 In addition to the local laws and regulations the Contractor shall also comply with the Minimum Wages Act and the Payment of Wages Act (both of the Government of India) and the rules made there under in respect of its labour and the labour of its sub-contractors currently employed on or connected with the contract.

- 37.2 All registration and statutory inspection fees, if any, in respect of his work pursuant to this Contract shall be to the account of the Contractor. However, any registration, statutory inspection fees lawfully payable under the provisions of the Indian Boiler Regulations and any other statutory laws and its amendments from time to time during erection in respect of the plant equipment ultimately to be owned by the Employer, shall be to the account of the Employer. Should any such inspection or registration need to be re-arranged due to the fault of the Contractor or his Sub-Contractor, the additional fees to such inspection and/or registration shall be borne by the Contractor.

38 ACCESS TO SITE AND WORKS ON SITE

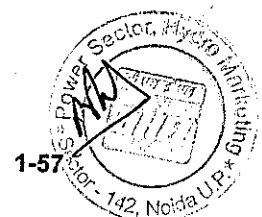
- 38.1 Suitable access to site and possession of the Site shall be afforded to the Contractor by the Employer in reasonable time.
- 38.2 In the execution of the Works, no person other than the Contractor or his duly appointed representative, Sub-Contractor and workmen, shall be allowed to do work on the Site, except by the special permission, in writing by the Employer or his representative.

39 CONTRACTOR'S SITE OFFICE ESTABLISHMENT

The Contractor shall establish a Office at the Site and keep posted an authorised representative for the purpose of the Contract. Any written order or instruction of the Employer or his duly authorised representative shall be communicated to the said authorised resident representative of the Contractor and the same shall be deemed to have been communicated to the Contractor at his legal address.



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CO-OPERATION WITH OTHER CONTRACTORS

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40.1

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

40.2 Employer shall give full access to visit the contractor's site at any time for inspection & surveillance checks.

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

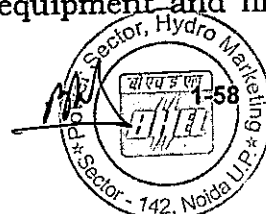
41 DISCIPLINE OF WORKMEN

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

42 CONTRACTOR'S FIELD OPERATION

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

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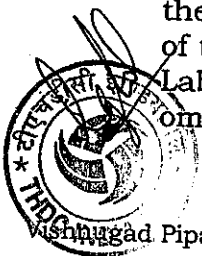
- 42.2 The Contractor shall have the complete responsibility for the conditions of the Work-Site including the safety of all person employed by him or his Sub-Contractor and all the properties under his custody during the performance of the work. This requirement shall apply continuously till the completion of the Contract and shall not be limited to normal working hours. The construction review by the Employer is not intended to include review of Contractor's safety measures in, on or near the Work-Site, and their adequacy or otherwise.

43 **PROTECTION OF WORK**

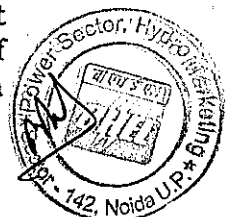
The Contractor shall have total responsibility for protecting his works till it is finally taken over by the Employer. No claim will be entertained by the Employer or the Employer for any damage or loss to the Contractor's works and the Contractor shall be responsible for complete restoration of the damaged works to original conditions to comply with the specification and drawings. Should any such damage to the Contractor's Works occur because or other party not being under his supervision or control, the Contractor shall make his claim directly with the party concerned. If disagreement or conflict or dispute develops between the Contractor and the other party or parties concerned regarding the responsibility for damage to the Contractor's Works the same shall be resolved as per the provisions contract document. The Contractor shall not cause any delay in the repair of such damaged Works because of any delay in the resolution of such disputes. The Contractor shall proceed to repair the Work immediately and no cause thereof will be assigned pending resolution of such disputes.

44 **EMPLOYMENT OF LABOUR**

- 44.1 In addition to all local laws and regulations pertaining to the employment of labour to be complied by the Contractor pursuant to GCC, the Contractor will be expected to employ on the work only his regular skilled employees with experience of his particular work. No female labour shall be employed after darkness. No person below the age of eighteen years shall be employed.
- 44.2 All travelling expenses including provisions of all necessary transport to and from Site, lodging allowances and other payments to the Contractor's employees shall be the sole responsibility of the Contractor.
- 44.3 The hours of work on the Site shall be decided by the Employer and the Contractor shall adhere to it.
- 44.4 Contractor's employees shall wear identification badges while on work at Site.
- 44.5 In case the Employer becomes liable to pay any wages or dues to the labour or any Government agency under any of the provisions of the Minimum Wages Act, Workmen Compensation Act, Contract Labour Regulation Abolition Act or any other law due to act of omission of the Contractor, the Employer may make such



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payments and shall recover the same from the Contractor's Bills.

45 FACILITIES TO BE PROVIDED BY THE EMPLOYER

45.1 Space

The Contractor shall advise the Employer within thirty (30) days from the date of acceptance of the Notification of Award about his exact requirement of space for his office, storage area, pre-assembly and fabrication areas, labour and staff colony area, toilets, etc. The above requirement shall be reviewed by the Employer and space as decided by Employer will be allotted to the Contractor for construction of his temporary structures/ facilities like office, storage sheds, pre-assembly and fabrication areas labour and staff colony, toilets, etc. for Contractor's as well as his Sub-Contractor's use.

45.2 Electricity

The Contractor shall submit to the Employer within thirty (30) days from the date of acceptance of the Notification of Award, his electrical power requirements, if any, to allow the planning of the same by the Employer. The supply of electric power for the main works of construction and domestic purpose will be provided by owner at minimum 2 points (one each at work site & colony) at 11kV, 3 phase 50 c/s . The charges for this purposes will be at the prevailing rate of state electricity utility. The Contractor shall make his own further distribution arrangement. All temporary wiring must comply with local regulations and will be subject to Employer inspection and approval before connection to supply.

45.3 Water

Contractor shall make all arrangements himself for the supply of construction water as well as potable water for labour and other personnel at the worksite /colony.

45.4 Communication :

The employer will extend the telephone facilities, if available at site, for purpose of contract. The Contractor shall be charged at actuals for such facilities.

46 FACILITIES TO BE PROVIDED BY THE CONTRACTOR

46.1 Contractor's site office Establishment

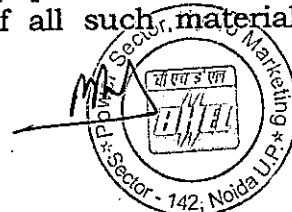
The Contractor shall establish a site office at the site and keep posted an authorized representative for the purpose of the contract, pursuant to GCC.

46.2 Tools, tackles and scaffoldings

The Contractor shall provide all the construction equipments, tools, tackles and scaffoldings required for pre-assembly, erection, testing and commissioning of the equipments covered under the Contract. He shall submit a list of all such materials to the



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Employer before the commencement of pre-assembly at Site. These tools and tackles shall not be removed from the Site without the written permission of the Employer. The Contractor shall arrange Dozer, Hydra, Cranes, Tractor, etc. for the purpose of fabrication, erection and commissioning.

46.3 First-aid

- 46.3.1 The Contractor shall provide necessary first-aid facilities for all his employees, representatives and workmen working at the Site. Enough number of Contractor's personnel shall be trained in administering first-aid.
- 46.3.2 The Employer will provide the Contractor, in case of any emergency, the services of an ambulance for transportation to the nearest hospital.

46.4 Cleanliness

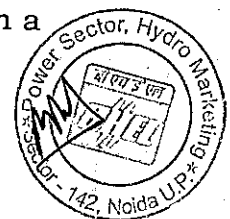
- 46.4.1 The Contractor shall be responsible for keeping the entire area allotted to him clean and free from rubbish, debris etc. during the period of Contract. The Contractor shall employ enough number of special personnel to thoroughly clean his work-area at least once in a day. All such rubbish and scrap material shall be stacked or disposed in a place to be identified by the Employer. Materials and stores shall be so arranged to permit easy cleaning of the area. In areas where equipment might drip oil and cause damage to the floor surface, a suitable protective cover of a flame resistant, oil proof sheet shall be provided to protect the floor from such damage.
- 46.4.2 Similarly the labour colony, the offices and the residential areas of the Contractor's employees and workmen shall be kept clean and neat to the entire satisfaction of the Employer. Proper sanitary arrangements shall be provided by the Contractor, in the work-areas, office and residential areas of the Contractor.

47 CONSTRUCTION MANAGEMENT

- 47.1 The field activities of the Contractors working at Site, will be coordinated by the Employer and the Employer decision shall be final in resolving any disputes or conflicts between the Contractor and other Contractors and tradesmen of the Employer regarding scheduling and co-ordination of work. Such decision by the Employer shall not be a cause for extra compensation or extension of time for the Contractor.
- 47.2 The Employer shall hold weekly meetings of all the Contractors working at Site, at a time and place to be designated by the Employer. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Employer and shall strictly adhere to those decisions in performing his Works. In addition to the above weekly meeting, the Employer may call for other meeting either with individual Contractors or with selected number of Contractors and in such a case the Contractor if called, will also attend such meetings.



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

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47.4 The Employer shall however not be responsible for provision of additional labour and/or materials or supply or any other services to the Contractor except for the co-ordination work between various Contractors as set out earlier.

48 FIELD OFFICE RECORDS

The Contractor shall maintain at his Site Office up-to-date copies of all drawings, specifications and other Contract Documents and any other supplementary data complete with all the latest revisions thereto. The Contractor shall also maintain in addition the continuous record of all changes to the above Contract Documents, drawings, specifications, supplementary data, etc. effected at the field and on completion of his total assignment under the Contract shall incorporate all such changes on the drawings and other Engineering data to indicate as installed conditions of the equipment furnished and erected under the Contract. Such drawings and Engineering data shall be submitted to the Employer in required number of copies.

49 PROTECTION OF PROPERTY AND CONTRACTOR'S LIABILITY

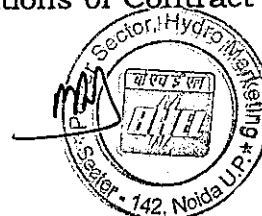
49.1 The Contractor shall be responsible for any damage resulting from his operations. He shall also be responsible for protection of all persons including members of public and employees of the Employer and the employees of other Contractors and Sub-Contractors and all public and private property including structures, building, other plants and equipments and utilities either above or below the ground.

49.2 The Contractor will ensure provision of necessary safety equipment such as barriers, sign-boards, warning lights and alarms, etc. to provide adequate protection to persons and property. The Contractor shall be responsible to give reasonable notice to the Employer and the Employers of public or private property and utilities when such property and utilities are likely to get damaged or injured during the performance of his Works and shall make all necessary arrangements with such Employers, related to removal and/or replacement or protection of such property and utilities.

50 INSURANCE FOR CONTRACTOR'S EMPLOYER AT SITE

50.1 In addition to the conditions covered under the Clause entitled "Insurance" in Section General Conditions of Contract (GCC), the

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following provisions will also apply to the portion of works to be done beyond the Contractor's own or his Sub-Contractor's manufacturing Works.

50.2 **Workmen's Compensation Insurance**

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

50.3 **Comprehensive Automobile Insurance**

This insurance shall be in such a form to protect the Contractor against all claims for injuries, disability, disease and death to members of public including the Employer's men and damage to the property of other arising from the use of motor vehicles during on or off the Site operations, irrespective of the Ownership of such vehicles. The liability covered shall be as herein indicated :

Fatal Injury	:	Rs.100,000 each person
	:	Rs.200,000 each occurrence

Property Damage	:	Rs.100,000 each occurrence
-----------------	---	----------------------------

50.4 **Comprehensive General Liability Insurance**

50.4.1 The insurance shall protect the Contractor against all claims arising from injuries, disabilities, disease or death of members of public or damage to property of others, due to any act or omission on the part of the Contractor, his agents, his employees, his representatives and Sub-Contractors or from riots, strikes and civil commotion. This insurance shall also cover all the liabilities of the Contractor arising out of the Clause entitled "Defence of Suits" in Section General Conditions of Contract (GCC).

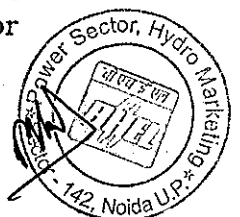
50.4.2 The hazards to be covered will pertain to all the Works and areas where the Contractor, his Sub-Contractors, his agents and his employees have to perform work pursuant to the Contract.

50.4.3 The above are only illustrative list of insurance covers normally required and it will be the responsibility of the Contractor to maintain all necessary insurance coverage to the extent both in time and amount to take care of all his liabilities either direct or indirect, in pursuance of the Contract.



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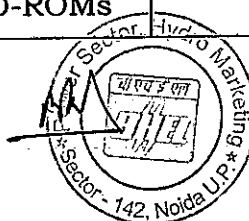
ANNEXURE-I

NUMBER OF COPIES OF DRAWING AND DOCUMENTS

Sl. No.	DESCRIPTION	NO. OF PRINTS	NO. OF CD-ROMs (SETS)	NO. OF MANUALS (SETS)
1.	PLANT DEFINITION MANUAL	-	3 CD-ROMs	10
2.	Drawings "FOR APPROVAL"	4	1 CD-ROM or Soft Copies by E-Mail	-
3.	Drawings "FOR INFORMATION"	4	1 CD-ROM or Soft Copies by E-Mail	-
4.	Drawings "FINAL DRAWING"	10	3 CD-ROMs	-
5.	Drawings "AS BUILT"	10	3 CD-ROMs	-
6.	DATA SHEETS, DESIGN CALCULATIONS, PURCHASE SPECIFICATIONS, etc. and Other type of documents.			
	i) For Approval	4	3 CD-ROMs/Soft Copies by E-Mail	-
	ii) FINAL	10	3 CD-ROMs	-
	iii) Analysis reports of equipments / structures components / systems employing software packages as detailed in the specifications			
	a) Input	4	3CD-ROMs	-
	b) Output	4	3CD-ROMs	-



Vishnugad Pipalkoti Hydroelectric Project



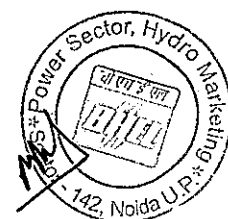
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Sl. No.	DESCRIPTION	NO. OF PRINTS	NO. OF CD-ROMs (SETS)	NO. OF MANUALS (SETS)
	c) Drawings / Sketches	4	3CD-ROMs	-
7.	Erection manual "DRAFT"	-	1 CD-ROM or Soft Copies by E-Mail	4
8.	Erection manual "FINAL"	-	3CD-ROMs	10
9.	Operation & Maintenance manual "DRAFT"	1	1 CD-ROM or Soft Copies by E-Mail	4
10.	Operation & Maintenance manual "FINAL"	-	3CD-ROMs	10
11.	Plant Hand Book "DRAFT"	1	1 CD-ROM or Soft Copies by E-Mail	4
12.	Plant Hand Book "FINAL"	3	3 CD-ROMs	10
13.	Commissioning and Performance Procedure manual "DRAFT"	1	3 CD-ROMs/ Soft Copies by E-Mail	4
14.	Commissioning and Performance Procedure manual "FINAL"	1	3 CD-ROMs	10
15.	Performance and Functional Guarantees test report	8	3 CD-ROMs	
16.	Progress Reports	8	3 CD-ROMs/ Soft Copies by E-Mail	
17.	Project completion report	15	3 CD-ROMs	-
18.	QA programme including Organisation for implementation and QA system manual (with revision servicing)	15	3 CD-ROMs	-

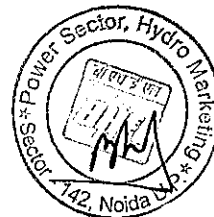


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Sl. No.	DESCRIPTION	NO. OF PRINTS	NO. OF CD-ROMs (SETS)	NO. OF MANUALS (SETS)
19.	Vendor details in respect of proposed vendors, including Contractor's evaluation report.	1	-	-
20.	Manufacturing QP's, Field QPs, Field welding schedules and their reference documents like test procedures, WPS, POR etc.			
	i) For review / comment	3	-	-
	ii) For final approval	4	1 CD-ROM 1	
21.	Welding Manual, Heat Treatment Manuals, Storage & preservation manuals			
	i) Draft	-	-	4 sets
	ii) Final	-	2 CD-ROMs	4 sets
22.	Monthly Vendor Approval and QP approval status	2	1 CD-ROM or Soft Copies by E-Mail	
23.	QA Documentation package for items / equipment manufactured and despatched to site.	2	2 CD-ROMs	
24.	QA Documentation Package for field activities on equipment / system at site.	2	2 CD-ROMs	



Vishnugad Pipalkoti Hydroelectric Project

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THDC INDIA LIMITED

(A Joint Venture of Govt. of India & Govt. of U.P.)
Pragati Bhawan, Pragatipuram, Bypass Road, Rishikesh

UTTARAKHAND, INDIA



BIDDING DOCUMENT

FOR

Engineering, Procurement and Construction (EPC) covering all
Electro- Mechanical Equipment Works for the execution of
Vishnugad Pipalkoti Hydro Electric Project (4x111 MW)

ICB No. : THDC/RKSH/CC-297

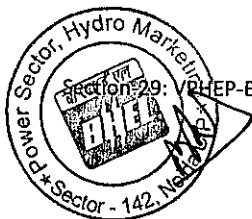
Part-2: Section VI "Employer's Requirement"

Quality Assurance & Inspection Requirements (Section-29)

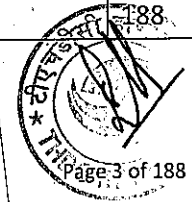
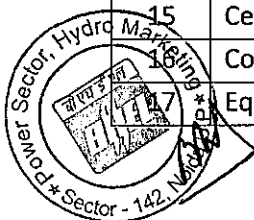


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QA&I: Vishnugad-Pipalkoti HEP (4x111 MW)

General



Section 29: PHEP-EM Works-QAI Requirement

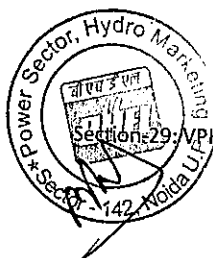


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1.0 DEFINITIONS/ VOCABULARY

Accept-as-it-is: A disposition which may be imposed for non- conformance when it can be established that the discrepancy will result in no adverse conditions and that the item under- consideration will continue to meet all engineering functional requirements including performance, maintainability, fitness to use and safety.

Assessment : An appraisal to evaluate the Contractor/Sub-Contractor's manufacturing, testing and quality management systems to ensure that:

- (a) Contractor/Subcontractor is capable of manufacturing the product as per specific requirement.
- (b) Contractor/Subcontractor is reliable in terms of consistency of quality.

Calibration: A comparison between a measuring instrument or equipment with a standard/ higher accuracy instrument/ equipment to detect, correlate, adjust the accuracy of the measuring instrument or equipment being compared or tested.

C.H.P.: CHP "Customer Hold Point" is a stage identified by customer in Quality Plan, which is to be offered to customer or its authorised representative for witnessing, verification or review, beyond which work will not proceed without written consent of the Inspecting Authority.

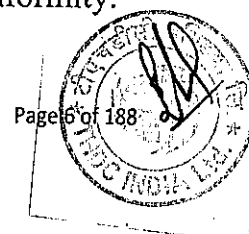
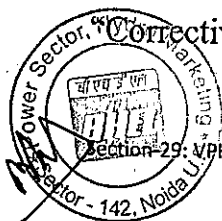
Corrective action:

Action taken to eliminate the cause of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. The corrective actions may involve changes, such as procedures and systems, to achieve quality improvement at any stage of the quality loop.

There is a distinction between "correction" and "corrective action".

"Correction" refers to repair, rework or adjustment and relates to the disposition of an existing nonconformity.

"Corrective action" relates to the elimination of the causes of nonconformity.



Data Book - Manufacturer's data book provides the record of observations clearances, test results, material certificates etc. of equipment during the manufacture.

Despatch Schedule - A document mutually agreed between purchaser and equipment supplies for the sequential and timely despatch of materials required at site.

Disposition of Nonconformity

Action to be taken to deal with an existing nonconforming entity in order to resolve the nonconformity.

The action may be in form of, for example, correction such as repair or rework, regrade, scrap, concession and amendment of a document or a requirement.

Disposition - Instructions for acceptance of re-work or rejection of non-conformities.

Equipment - An assembly of components which can perform independent function shall be called 'Equipment'.

Field welding schedule sheet - The form used to document field weld locations, numbers, welding procedure to be used, requirements, code and NDE requirements for a specific contract.

Inspection - The process of measuring, examining, testing gauging or otherwise comparing one or more characteristics of the product or service with the specified requirements.

Major Non-conformances : Major non-conformances are those which have a direct or indirect adverse effect on performance, reliability, safety, interchangeability, maintainability, working life or on site activities of the material, equipment or service.

MDCC - MDCC "Material Dispatch Clearance Certificate" issued by Employer's Engineer-in-Charge/ Authorized representative authorizing dispatch of items after satisfactory completion of all tests/checks.

Minor Non-conformances - All other Non-Conformances not covered in "Major Non-Conformances" shall be considered "Minor Non-conformity".



Section-29: VPHEP-EM Works-QAI Requirement



Measuring equipment – All devices used to measure, gauge test, inspect or otherwise quantify the characteristics of an article.

N.D.E. - Non-destructive examination includes, but not limited to, radiographic examination, magnetic particle examination, ultrasonic examination, liquid, penetrant examination and steelosopic examination.

Non-conforming items - A deficiency in characteristics, documentations on procedure which renders the quality of an item unacceptable or indeterminate.

Non-Conformity – Non fulfillment of a specified requirement – The definition covers the departure or absence of one or more quality characteristics (including dependability characteristics) or quality system elements from specified requirements.

Non-Conformity Dispositioning Request: Non-Conformity Dispositioning Requests are formal requests from Contractors/ suppliers to deviate from a specified quality requirement, Nonconformities are to be detected and reported as soon as possible.

Process - Procedure or techniques followed in the production or erection of a product.

Pre-commissioning- All activities pertaining to individual starting and trial run of individual equipment or upto first rolling of turbo-set, whichever is later.

Plant - A combination of equipment working together to perform one single function shall be called plant.

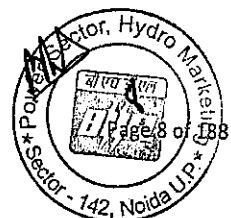
Quality - The totality of features and characteristics (attributes) of a product or service that qualifies it to satisfy a given need.

Quality Audit: An activity to determine through investigation the adequacy of an adherence to established procedures, instructions, specifications, code and standards and other contractual requirements and the effectiveness of implementation.

Quality Assurance - All those planned and systematic actions necessary to provide adequate confidence that an item, equipment or a system will perform satisfactorily in service.



Section-29: VPHEP-EM Works-QAI Requirement



Quality Control: Actions stipulated on quality assurance plan which provide a mean to control and measure the characteristics of an item, process or facility to established requirements.

Quality Plan - A document setting out the specific quality practices and procedures relevant to a particular component, part or a material.

Quality Programme - Overall management and procedures for the execution of a specific contract or project.

Quality Manual - A document specifying the general quality policies and practices of an organisation.

Record: A document which furnishes objective evidence of activities performed or results achieved.

Reliability - The probability of a device, system or facility performing satisfactorily for a specified time under stated operating conditions.

Repair - Action taken on non-conforming product so that it will fulfill the intended usage requirements although it may not conform to the originally specified requirements.

Rework - Action taken on a nonconforming product so that it will fulfill the specified requirements.

Standard - An instrument, device or material of known characteristics and higher precision used to establish and maintain the accuracy of a measurement system or device.

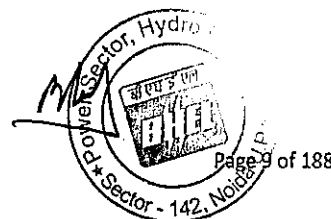
Verification - An act of conforming, substantiating and assuring that an activity or condition has been implemented in conformance with the specified requirements.

Welding Procedure Qualification Record - A WPQR is a record of Welding data used to weld a test coupon. The WPQR is a record of variables recorded during the welding of test coupons. It also contains the test results of the tested specimen. Recorded variables normally fall within a small range of the actual variables that will be used the production welding.

Welding Procedure Specification - A form giving the details of welding procedures such as base material, filler materials, range of preheat and post weld heat treatment temperature, thickness etc.



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2.0 A: GENERAL TECHNICAL REQUIREMENTS

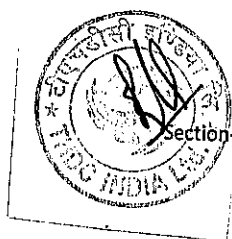
1.00.00 INTRODUCTION

This part covers general technical requirements which will form an integral part of the Contract. The following provisions shall supplement all the detailed technical specifications and requirements brought out in the technical Specification and the Technical Data Sheets.

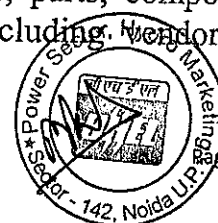
2.00.00 QUALITY ASSURANCE PROGRAMME

2.01.01 THDC has adopted a Model Quality Management System Manual available at THDC website www.thdc.gov.in. The Contractor shall prepare a suitable **Project Quality Management Plan (PQMP)** - a quality assurance programme based on THDC's Model Quality Management System Manual and shall submit the same for client's approval to ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications. Such PQMP shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before award of the contract. The QA programme shall be generally in line with IS/ISO-9001/other international standards. A Quality Assurance programme of the contractor shall generally cover the following:

- i. His organization structure for the management and implementation of the proposed quality assurance programme
- ii. Quality System Manual
- iii. Design Control System
- iv. Documentation and Data Control System
- v. Qualification data for Bidder's key Personnel.
- vi. QA Co-ordination Procedure of Contractor for his in-house and sub-supplier's manufacturing and field activities.
- vii. The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis,



Section-29: VPHEP-EM Works-QAI Requirement



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source inspection, incoming raw-material inspection, verification of materials purchased etc.

- viii. System for shop manufacturing and site erection controls including process, fabrication and assembly.
- ix. Control of non-conforming items and system for corrective actions and resolution of deviations.
- x. Inspection and test procedure both for manufacture and field activities.
- xi. Control of calibration and testing of measuring testing equipments.
- xii. System for Quality Audits.
- xiii. System for identification and appraisal of inspection status.
- xiv. System for authorising release of manufactured product to the Employer.
- xv. System for handling, storage and delivery.
- xvi. System for maintenance of records, and
- xvii. Quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component.

2.01.02 QA CO-ORDINATION PROCEDURE

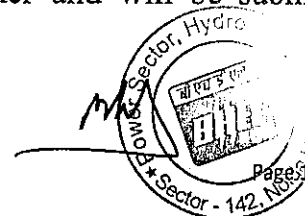
A QA Co-ordination Procedure shall be adopted by all parties to the Contract for smooth functioning of QA&I activities as annexed at Annexure-CP.

2.02.00 GENERAL REQUIREMENTS - QUALITY ASSURANCE

- 2.02.01 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to



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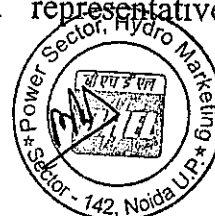
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Employer for approval. Schedule of finalisation of such quality plans will be finalised before award.

- 2.02.02 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media e.g. floppy or E-mail in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD ROM.
- 2.02.03 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site.
- 2.02.04 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Engineer-in-charge or his authorised representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.
- 2.02.05 No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to pre-despatch final inspection including verification of records of all previous tests/inspections by Employer's Engineer-in-charge/Authorised representative and duly



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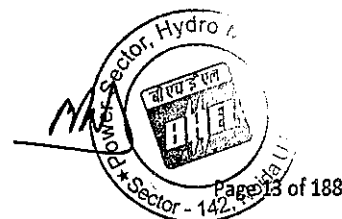
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authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC).

- 2.02.06 All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties, chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.
- 2.02.07 The contractor shall submit to the Employer Field Welding Schedule for field welding activities. The field welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least, unless otherwise specified in Employer's Requirement, ninety days before schedule start of erection work at site.
- 2.02.08 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer.
- All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.
- 2.02.09 All brazers, welders and welding operators employed on any part of the contract either in Contractor's/sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.
- 2.02.10 Welding procedure qualification & Welder qualification test results shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorised representative.
- 2.02.11 Any other statutory requirements as applicable for the equipments/systems shall also be complied with.



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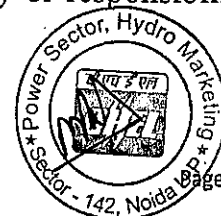
- 2.02.12 Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.
- 2.02.13 No welding shall be carried out on cast iron components for repair.
- 2.02.14 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
- 2.02.15 All non-destructive examination shall be performed in accordance with written procedures as per International Standards, The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.

All plates of thickness above 40mm & all bar stock/Forging above 40mm dia shall be ultrasonically tested. For pressure parts, plate of thickness equal to or above 25mm shall be ultrasonically tested.

- 2.02.16 The Contractor shall list out all major items/ equipments/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the sub-contractor proposed by the Contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Contractor and finalised with the Employer, shall be subject to Employer's approval. The contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion and identified in "DR" category prior to any procurement. Monthly progress report on sub-contractor details submission / approval shall be furnished. Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.



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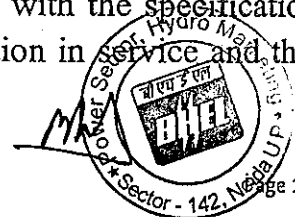


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- 2.02.17 For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. Within three weeks of the release of the purchase orders/contracts for such bought out items/components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the monthly basis by the Contractor along with a report of the Purchase Order placed so far for the contract.
- 2.02.18 Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-contractor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.
- 2.02.19 The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipments conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.
- 2.02.20 Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above



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shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.

2.02.21 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.

2.02.22 Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.

2.03.00 Burn in and Elevated Temperature Test Requirement for Electronics Solid State Equipment

2.03.01 All solid state electronic systems/equipment shall be tested as a complete system/equipment with all devices connected for a minimum of 168 hours (7 Days) continuously under energized conditions prior to shipment from manufacturing works, as per the following cycle.

2.03.02 Elevated Temperature Test Cycle

During the elevated temperature test which shall be for 48 hours of the total 168 hours of testing, the ambient temperature shall be maintained at 50 deg.C. The equipment shall be interconnected with devices which will cause it to repeatedly perform all operations it is expected to perform in actual service with load on various components being equal to those which will be experienced in actual service.

During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components/modules shall be monitored. The temperature rise inside the cubicle should not exceed 10 deg.C above the ambient temp. at 50°C.

2.04.00 Burn in Test Cycle

The 48 hours elevated temperature test shall be followed by 120 hours of burn in test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time.

During the above tests, the process I/O and other load on the system shall be simulated by simulated inputs and in the case of control



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systems, the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable.

In case the Contractor/ sub-contractor is having any alternate established procedure of eliminating infant mortile components, the detail procedures followed by the Contractor/ sub- contractor along with the statistical figures to validate the alternate procedure to be forwarded.

- 2.04.01 The Contractor/Sub-contractor shall carry out routine test on 100% item at contractor/sub-contractor's works. The quantum of check/test for routine & acceptance test by employer shall be generally as per criteria/sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check/test for routine / acceptance test shall be as agreed during detailed engineering stage.

2.05.00 QA Documentation Package

The Contractor shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (✓) mark.

- 2.05.01 Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.

The QA Documentation file shall be progressively completed by the Supplier's sub- supplier to allow regular reviews by all parties during the manufacturing.

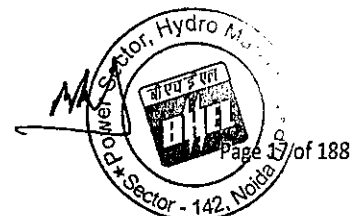
The final quality document will be compiled and issued at the final assembly place of equipment before despatch. However CD Rom may be issued not later than three weeks.

- 2.05.02 Typical contents of QA Documentation is as below:-

- i) Quality Plan
- ii) Material mill test reports on components as specified by the specification and approved Quality Plans.
- iii) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.



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- iv) Non-destructive examination results /reports/films including radiography/Ultrasonic interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
- v) Heat Treatment Certificate/Record (Time- temperature Chart)
- vi) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure).
- vii) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points.
- viii) Certificate of Conformance (COC) wherever applicable.
- ix) MDCC

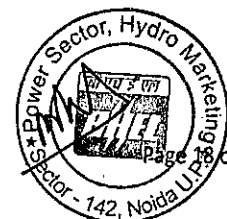
2.05.03 Similarly, the contractor shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.

2.05.04 Before despatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

- i) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.
- ii) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.



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iii) If a decision is made to despatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the despatch of equipment.

2.06.00 Transmission of QA Documentation

On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Quality Assurance Department and other set to respective Project Site of Employer.

For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 3 weeks after the date of the last delivery of equipment.

2.07.00 Engineer-in-charge Supervision

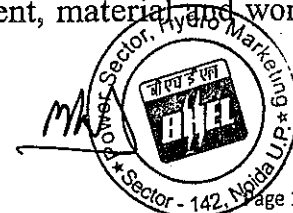
2.07.01 To eliminate delays and avoid disputes and litigation, all matters and questions shall be referred to the Engineer-in-charge and without prejudice to the provisions of Arbitration clause in Contract, the Contractor shall proceed to comply with the Engineer-in-charge decision.

2.07.02 The work shall be performed under the supervision of the Engineer-in-charge. The scope of the duties of the Engineer-in-charge pursuant to the Contract will include but not be limited to the following:

- i) Interpretation of all the terms and conditions of these documents and specifications:
- ii) Review and interpretation of the entire Contractor's drawing, engineering data, etc:
- iii) Witness or his authorized representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract
- v) Inspect, accept or reject any equipment, material and work under the contract



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- vi) Issue certificate of acceptance and/or progressive payment and final payment certificates
- vii) Review and suggest modifications and improvement in completion schedules from time to time, and
- viii) Supervise Quality Assurance Programme implementation at all stages of the works.

2.08.00 Inspection, Testing and Inspection Certificates

2.08.01 The word 'Inspector' shall mean the Engineer-in-charge and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.

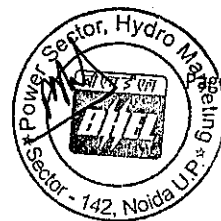
2.08.02 The Engineer-in-charge or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Engineer-in-charge and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.

2.08.03: The Contractor shall give the Engineer-in-charge/ Inspector, unless otherwise specified in Employer's Requirement, **twenty one (21) working days written/electronically advance notice** of any material being ready for testing **alongwith a copy of factory test reports**. The Engineer-in-charge/Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within, unless otherwise specified in Employer's Requirement, **twenty one (21) working days** of the date on which the equipment is noticed as being ready for test/inspection. Such tests shall be to the Contractor's account except for the expenses of the Inspectors.

2.08.04 The Engineer-in-charge or Inspector shall, unless otherwise specified in Employer's Requirement, within **twenty one (21) working days** from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings



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and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Engineer-in-charge/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.

2.08.05 When the factory tests have been completed at the Contractor's or sub-contractor's works, the Engineer-in-charge /Inspector shall issue a certificate to this effect, unless otherwise specified in Employer's Requirement, ten (10) working days after completion of tests but if the tests are not witnessed by the Engineer-in-charge/ Inspectors, the certificate shall be issued, unless otherwise specified in Employer's Requirement, within ten (10) working days of the receipt of the Contractor's test certificate by the Engineer-in-charge /Inspector. Engineer-in-charge /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.

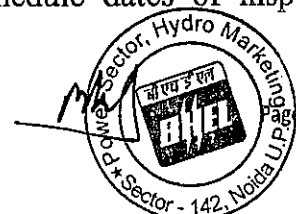
2.08.06 In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments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

2.08.07 The inspection by Engineer-in-charge / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.

2.08.08 To facilitate advance planning of inspection in addition to giving inspection notice as above, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at



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Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

2.08.09 All inspection, measuring and test equipments used by contractor shall be calibrated periodically depending on its use and criticality of the test/ measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by THDC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipments in the presence of Engineer-in-charge / Inspector.

2.08.10 All the Type tests, Routine tests, Site tests, Commissioning/Pre-Commissioning tests, Acceptance tests, Special tests and any other tests mentioned in the technical specifications (not covered in the attached QA &I Requirements) shall be executed in the spirit it is defined in the technical specifications and they shall form part of the Quality Assurance Plan.

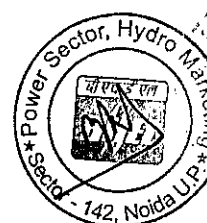
2.09.00 **Erection Manuals**

The erection manuals shall be submitted at least three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum.

- a) Erection strategy.
- b) Sequence of erection.
- c) Erection instructions.
- d) Critical checks and permissible deviation/tolerances.
- e) List of tool, tackles, heavy equipments like cranes, dozers, etc.



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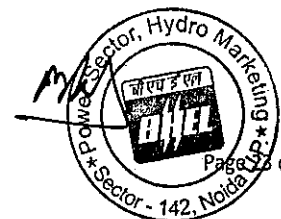


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- f) Bill of Materials
- g) Procedure for erection.
- h) Procedure for initial checking after erection.
- i) Procedure for testing and acceptance norms.
- j) Procedure / Check list for pre-commissioning activities.
- k) Procedure / Check list for commissioning of the system.
- l) Safety precautions to be followed in electrical supply distribution during erection

2.10.00 Associated Document for Quality Assurance Programme:

- 2.10.01 Manufacturing Quality Plan Format NO.: QS-01-QAI-P-06/F1-R0
Field Quality Plan Format NO.: QS-01-QAI-P-06/F2-R0
- 2.10.02 Status of Items requiring Quality Plan and Sub-supplier approval
Format no.: QS-01- QAI-P-02/F1-R0
- 2.10.03 List of Items requiring Quality Plan and sub-supplier approval
Format no.: QS-01- QAI-P-01/F3-R0
- 2.10.04 Main Contractor's Evaluation Report
Format no.: QS-01-QAI-P-04/F1-R1
- 2.10.05 Sub-supplier questionnaire format no.: QS-01-QAI-P-04/F2-R1



ANNEXURE-CPQA CO-ORDINATION PROCEDURE

As mentioned at Cl.2.01.02, a QA Co-ordination Procedure shall be adopted for smooth functioning QA&I activities as follows:

1. PURPOSE:

This document specifies procedure to be adopted for the coordination of QA&I activities relating to Electro-Mechanical Package of Vishnugad Pipalkoti Hydro Electric Project (VPHEP) to satisfy the QA requirements laid down in the Contract.

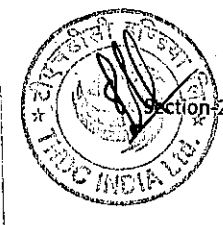
2. SCOPE:

This document shall specify procedure of:

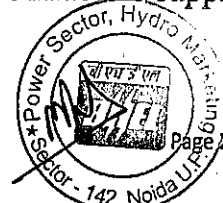
- Level-1 & Level-2 vendor approval / finalization.
- Quality Plan: Bought-out items/Manufacturing items Approval/finalization.
- Field Quality Plan approval/finalization.
- Inspection/Testing of equipments/items.
- Dispositioning of Non-conformities.
- Dispatch clearance of equipments/items.
- QA documentation Package
- Quality audit & surveillance.

3. DEFINITIONS:

- 3.1 THDC/Consultant Inspector:** Means THDC/Consultant's own inspector/duly authorized third party inspection agency.
- 3.2 Resident Inspector:** Means THDC/Consultant's own inspector/ inspector of authorized third party posted in the country of origin of the equipment or manufacturing works and Consultant Inspectors at Regional Inspection Offices and at works.
- 3.3 Level-1 sub-contractor/ sub-vendor/ sub-supplier:**
Vendors/Contractors/Suppliers of successful bidder on whom order shall be placed for complete system/equipment.
- 3.4 Level-2 sub-contractor/ sub-vendor/ sub-supplier:**
Vendors/Contractors/Suppliers of Level-1 vendors/ contractors/supplier



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4. PROCEDURE:

4.1 CO-ORDINATORS AND CORRESPONDANCE

4.1.1. Overall QA co-ordinator of successful bidder for this contract shall be informed to the Owner within four weeks from the issue date of letter of award of work.

4.1.2. Web-based system for Quality Assurance & Inspection activities adopted by THDC India Ltd. shall be followed for implementation of present quality system or any updation from time to time.

4.2 VENDOR APPROVAL

4.2.1 List of items requiring Quality Plan and sub-vendor/ sub-supplier approval shall be furnished by Bidder covering scope of supply, their sub-vendors/sub-suppliers and quality plan requirements. This list shall be finalized with successful bidder during pre-award stage before award of work. However, the list of Level-2 sub-vendors shall be furnished by the Contractor after award of the work.

Vendors proposed by successful bidder and acceptable to THDC/ Consultant shall be put under 'APPROVED' category. Vendors not known to THDC/Consultant or with whom THDC/Consultant do not have past experience and for which details are required to be submitted by the Contractor, shall be put under 'DR' category (Details Required). Contractor's approved vendor shall be accepted in 'NOTED' category and indicated by 'N' by owner for this project based on the Contractor's experience with the vendor for the item without specific vendor approval.

Certificate of consent from vendors/ suppliers to execute the work proposed by the Contractor shall be submitted with above list.

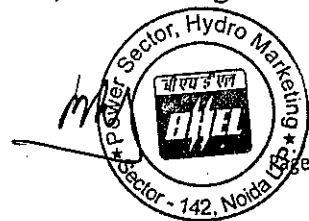
4.2.2 The Contractor shall finalize vendors from the vendors list mutually agreed in Clause 4.2.1. The Contractor shall not propose any "DR" category or additional vendor in post-award stage for items for which there are three or more vendors identified as acceptable ("Approved"/"Noted") during pre-award stage, except in following circumstances/ cases:

- i. Where any item is added on list of items for vendor approval or type/ design of an item is changed during detailed engineering.
- ii. Where the Contractor is confronted with a situation such that supplies from already approved sources is not possible.

In such case, the proposal for additional vendor shall be made by Head (Quality) of the Contractor to Head (QA&I) of OWNER, furnishing reasons and justification for such consideration.



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4.2.3 The Contractor shall submit complete vendor/ supplier details in enclosed prescribed format No. QS-01-QAI-P04/F2 for "DR" Category vendors in SINGLE submission to THDCIL for review and approval of vendors. The details will include following:

- (a) Manufacturing & testing facilities, organisational set up including catalogue/drg. giving constructional details.
- (b) System & procedure of proposed vendor followed for inspection & testing of various items covered in this scope.
- (c) Contractor's Evaluation Report in the prescribed format No. QS-01-QAI-P04/F1-R1.
- (d) Relevant POs placed by the Contractor and executed by the vendor.
- (e) Vendor's own experience including Field Performance Report from the end-users for similar size/rating, application and material. Experience detail shall include PO details, date of supply and commissioning.

Additional details of vendor, in addition to above, if required, may also be asked by Owner for vendor assessment.

The submission of above details shall be as per mutually agreed schedule in line with project schedule requirements.

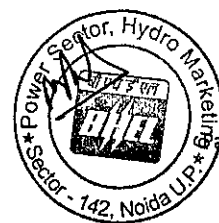
4.2.4 Above details of DR category vendors shall be furnished by the Contractor to THDCIL within six months of award of the contract by THDCIL, in case of items to be ordered in first nine months, prior to placement of purchase order on the vendor for other items. The vendor proposals in 'DR' Category, where complete details are not furnished within the above period shall be considered withdrawn by the Contractor. On receipt of complete vendor details in all such DR cases, THDCIL/ Consultant shall process the vendor proposals and shall furnish their decision within eight weeks from receipt of complete details.

4.2.5 Monthly progress report of vendor approval for vendors identified in 'DR' category shall be furnished by the Contractor's overall co-ordinator.

4.2.6 Within three weeks of release of Purchase Order for bought out items/ components, the Contractor shall furnish to THDC a copy of the Purchase Order without price details but together with detailed purchase technical specification and delivery conditions.



Section-29: VPHEP-EM Works-QAI Requirement



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4.3 QUALITY PLANS

- 4.3.1 List of items requiring approval of Quality Plan by THDCIL shall be furnished by Bidder. This list shall be finalized at pre-award stage before award of the work. As detailed Engineering progresses, the list shall be adapted for addition/deletion of items.
- 4.3.2 The Contractor shall finalize a realistic schedule of submission and approval of Quality Plans based on project requirements within 6 weeks of date of LOA. The schedule shall be dovetailed with overall schedule of works in such a manner that the QP is approved at least 4 weeks prior to scheduled start of manufacturing of respective item and FQP is approved at least TWO months before scheduled start of respective field activity.
- 4.3.3 The Contractor shall submit to THDC/Consultant Quality Plans along with reference documents as per schedule of submission. The final submission of Quality Plans shall be furnished to THDC on a CD/DVD also in addition to hard copies.
- 4.3.4 Manufacturing Quality Plans shall be furnished by the Contractor along with all reference documents such as purchase specification/ details, approved drawing, data sheet and technical parameters, test procedure, manufacturer/plant standards, etc.
- 4.3.5 Monthly progress report of quality plan submission/approval shall be furnished by the Contractor's overall co-ordinator.

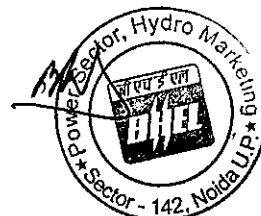
4.4 FIELD QUALITY PLAN

- 4.4.1 The Field Quality Plans for equipments and services shall be furnished by the Contractor and their Vendors so as to finalise the same at least 3 months prior to start of work and shall include the quality practices and procedures followed by them during various stages of site activities from receipt of material/equipment till final erection. The list of FQP to be approved by THDCIL shall include:

1. Material receipt & storage
2. Turbine & Aux.
3. Generator & Aux.
4. Penstock Inlet Valve
5. Main Inlet Valve (MIV)



Section-29 VPHEP-EM Works-QAI Requirement



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6. EOT Crane
7. AC & Ventilation & smoke Exhaust System
8. Fire Fighting System
9. Oil Handling System
10. Electrical Balance of Plant Items
11. C&I Items (Receipt, Storage)
12. Gates
13. Gantry Cranes
14. Penstock

4.4.2 The Contractor shall furnish list of Erection contractor for THDC approval/ acceptance.

4.5 INSPECTION

4.5.1 All inspection call shall be furnished to THDC. THDC in turn shall forward calls to Consultant as per their requirements to take up inspection at various RIOs. The notice period for inspection of materials/components/equipments for witnessing of the CHP stages by THDC/Consultant at the Level-1 vendors/Level-2 vendor's works shall be as follows:

- | | |
|-------------------------------|---------------------|
| (a) Vendors of Indian origin | - 21 working days |
| (b) Vendors of Foreign origin | - 60 days (initial) |
| -do- | - 15 days (final) |

4.5.2 Wherever THDC/Consultant resident inspectors are located at the Contractor's works, inspection notice shall be as mutually acceptable.

4.5.3 The Contractor shall issue inspection call notice to THDC QA Co-ordinator.

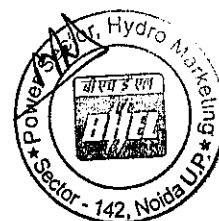
4.5.4 Where witnessing of the test is waived-off in writing by THDC, Contractor/vendors shall proceed with the test which shall be deemed to have been carried out in the presence of THDC/Consultant inspector and shall forward duly certified copies of the test reports to the concerned THDC/Consultant inspection office as follows:

- a. For the tests conducted within the Contractor's premises shall be within 10 days.
- b. For the tests conducted at vendors' premises shall be within 10 working days.

In case of any objection, the concerned THDC/Consultant-RIO office shall notify the same to the concerned the Contractor/vendors within 10 working days from receipt of the test reports.



Section-29: VPHEP-EM Works-QAI Requirement

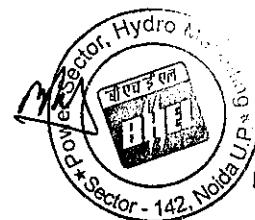


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- 4.5.5 For the witnessed tests, when the factory test at identified CHP stages have been satisfactorily completed including computation of test results wherever applicable, THDC/Consultant inspector shall sign jointly with the Contractor/vendors/ authorized representative (as applicable as per approved QAP) on the CHP Clearance/ Interim Inspection report in the format .
- 4.5.6 For the witnessed tests, in case of deviation, THDC/Consultant inspector shall convey their non-conformities in writing on the CHP Report itself for clarification by the Contractor /Vendors, who shall give due considerations to the objections raised and shall take corrective measures (as per the procedure laid down in clause 4.7 after due approval from THDC) to rectify the non-conformities and shall confirm in writing to the concerned inspection office on rectification of the objections raised. However decision of THDC shall be final and binding upon the Contractor/vendors within the purview of the contract requirements.
- 4.5.7 The Contractor will make available to the THDC/CONSULTANT inspector their relevant internal documents and plant standards/procedure relevant to the checks/tests carried out on material/items equipments. Further, the Contractor/vendors shall also ensure the availability of approved documents such as drawings/data sheets and approved Quality Plan etc. at the place of inspection.
- 4.5.8 **INSPECTION PLAN:** To facilitate advance planning of inspection of supplies, in addition to giving inspection notice at identified CHP stages as per approved QAP, the Contractor shall furnish three monthly rolling inspection programme every month indicating schedule dates of inspection at identified CHP stages. Such a programme shall be updated each month and a copy of the same is made available to the resident inspector/RIO as applicable. Such programme shall be confirmed by specific inspection call in accordance with clause 4.5.1 above.
- 4.5.9 Three-monthly inspection programme for shop manufactured & BOIs shall be furnished directly to THDC.
- 4.5.10 Contractor's QA shall furnish monthly inspection status report for previous month including pending calls and exception reports/NCR on or before 7th of every month.



Section-29: VPHEP-EM Works-QAI Requirement



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4.6 QUALITY AUDIT: CONTRACTOR /VENDORS shall provide the necessary facilities to THDC inspector/team for carrying out of the Quality Surveillance and Audits as envisaged in the contract.

4.7 NON-CONFORMITY DISPOSITIONING PROCEDURE:

4.7.1 Whenever any deviation is observed with respect to relevant document and good Engineering practices, the same shall be referred along with justification to THDC/Consultant office where inspection call has been raised by the Contractor/vendors. The details shall be furnished in the format attached for THDC/Consultant review and necessary action. Non-conformity Report (NCR) can be raised irrespective of the CHP stages to the concerned inspection office in whose jurisdiction the item/equipment is being manufactured.

4.7.2 Non-conformities with respect to the site activities shall also be dealt with similarly except that the NCR shall be routed through THDC-FQA group.

4.8 Material Despatch Clearance Certificate (MDCC):

4.8.1 Upon satisfactory completion of all tests/inspection including type test as required by the approved documents (Cat-1 approved Quality Plan drawing/data sheet etc. as applicable) MDCC shall be issued by THDC.

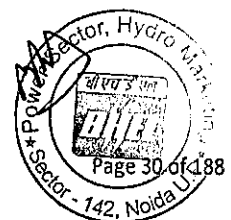
4.8.2 As per Tech specification, no item shall be despatched by the Contractor without obtaining MDCC/dispatch clearance in CHP report from THDC/Consultant.

4.9 QUALITY ASSURANCE DOCUMENTATION PACKAGES:

The Contractor shall submit to THDC QA the Quality Assurance documents in two hard copies and two CD ROM/DVD.



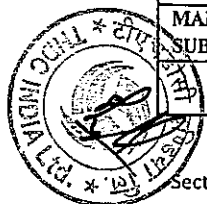
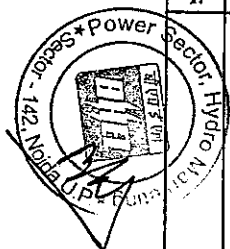
Section-29: VPHEP-EM Works-QAI Requirement



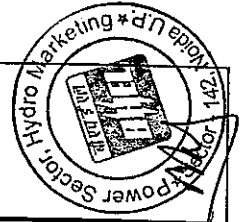
MFGR.'s LOGO	MANUFACTURER'S NAME AND ADDRESS	MANUFACTURING QUALITY PLAN		PROJECT :
		ITEM :	QP NO.:	PACKAGE :
		SUB-SYSTEM:	REV.NO.:	CONTRACT NO. :
			DATE:	MAIN-SUPPLIER:
			PAGE:	

SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N					M	C	T	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	** 10.			11.

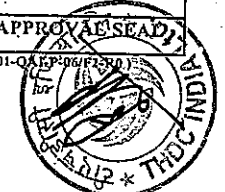
MANUFACTURER/ SUB-SUPPLIER		MAIN-SUPPLIER	LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: MANUFACTURER/SUB-SUPPLIER C: MAIN SUPPLIER, T: OWNER; P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE, CHP: OWNER SHALL IDENTIFY IN COLUMN "N" AS 'W'	FOR OWNER USE	DOC. NO.:		REV..... CAT.....	
SIGNATURE								
					REVIEWED BY	APPROVED BY	APPROVAL SEAL	



SUPPLIER'S LOGO	SUPPLIER'S NAME AND ADDRESS		FIELD QUALITY PLAN				PROJECT :			
			ITEM :	QP NO.:			PACKAGE :			
			SUB-SYSTEM:	REV. NO.:			CONTRACT NO.:			
				DATE:		MAIN-SUPPLIER :				
PAGE:										
SL. NO	ACTIVITY AND OPERATION	CHARACTERISTICS / INSTRUMENTS	CLASS OF CHECK #	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		REMARKS
1.	2.	3.	4.	5.	6.	7.	8.	9.	D*	10.



		LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. LEGEND TO BE USED: CLASS # : A = CRITICAL, B=MAJOR, C=MINOR; 'A' SHALL BE WITNESSED BY OWNER FQA, 'B' SHALL BE WITNESSED BY OWNER ERECTION / CONSTRUCTION DEPTT. AND 'C' SHALL BE WITNESSED BY MAIN SUPPLIER (A & B CHECK SHALL BE OWNER CHP STAGE)				DOC. NO.:		REV.....	
MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER			FOR THDC USE					
SIGNATURE						REVIEWED BY		APPROVED BY	
VISHNUGAD-PIPAKOTI HEP (4X111 MW) Section-29: VPHEP-EM Works-QAI Requirement								APPROVAL SEAD	

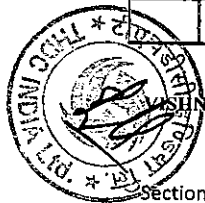


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QA: FIELD QUALITY PLAN

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FORMAT NO.: QS-01-QAI-P-001/2014

[illegible]

VISHNUGAD-PIPALKOTI HEP (4X111 MW)

QA: STATUS OF ITEM REQUIRING QP& SUB-SUPPLIER APPROVAL
FORMAT NO.: QS-01-QAI-P-02/FI- R0

1/1

[illegible]

LEGENDS

1. **SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY THDCIL)**
A – For these items proposed vendor is acceptable to THDCIL. To be indicated with letter “A” in the list alongwith the condition of approval, if any.
DR – For these items “Detailed required” for THDCIL review. To be identified with letter “DR” in the list.
NOTED – For these items vendors are approved by Main Supplier and accepted by THDCIL without specific vendor approval from THDCIL. To be identified with “NOTED.”
2. **QP/INSPECTION CATEGORY:**

CAT-II: For these items the Quality Plans are approved by THDCL. However no inspection by THDCL is envisaged. THDCL

The final acceptance by THDCL shall be on the basis review of documents as per approved OP.

UNITS WORKS Place of manufacturing Place of Main Supplier of material

UNIT/WORKS **Place of manufacturing** **Place of Main Supplier** **of multi units/works**

VISHNUGAD PIPALKOTI HEP (4X111 MW)

QA: STATUS OF ITEM REQUIRING QP& SUB-SUPPLIER APPROVAL
FORMAT NO.: QS-01-QAI-P-1/F3- R0

1/1

Section-29: VPHEP-EM Works-QAI Requirement

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MAIN CONTRACTOR'S EVALUATION REPORT (For Proposed Sub-Supplier)

1. MAIN CONTRACTOR : M/S _____

2. PACKAGE & PROJECT NAME : _____

3. BRIEF SPEC. OF EQUIPMENT / ITEM / : _____
PROCESS WITH MODEL / TYPE/ RATING /
CAPACITY/ SIZE/ TONNAGE ETC. (AS
APPLICABLE)

4. PROPOSED SUB-SUPPLIER'S : _____
NAME & WORKS ADDRESS

5. BASIS OF RECOMMENDATIONS:

a) Main contractor's own supply experience

REFERENCE LIST (EXPERIENCE FOR THE PARTICULAR TYPE OF EQUIPMENT / ITEM /PROCESS) OF MAIN CONTRACTOR:

CUSTOMER NAME, PROJECT NAME	TYPE / RATING / MODEL/ CAPACITY/ SIZE / TONNAGE ETC (AS APPLICABLE)	SUPPLIED QUANTITY	DATE OF SUPPLY	NO. OF YEARS IN OPERATION/ DATE OF COMMISSIONING (*)

b) In absence of own supply experience:

ENCLOSE MAIN CONTRACTOR'S ASSESSMENT REPORT AS PER THEIR VENDOR APPROVAL SYSTEM ()**

NAME : _____ DESIG. : _____ SIGN : _____ Date: _____

List of Encl.: (Pl. Tick)

(*) a. User Certificate ☐

(**) b. Self Assessment Report ☐

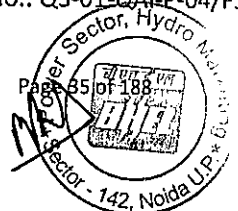
VISHNUGAD PIPALKOTI HEP(4X111MW)

1/1

Format No.: QS-01-QAI-P-04/F1-R1



Section-29: VPHEP-EM Works-QAI Requirement



SUB-SUPPLIER QUESTIONNAIRE
(To be filled in by the Proposed Sub Supplier)

Name of Equipment / Item / Process with Model/ Type/ Rating / Capacity/ Size/ Tonnage etc. (As applicable):

Trade Name of Product (if any) : _____

1. Name of Proposed Sub-Supplier: _____

Website: _____

2. Address of Regd. Office: _____

Details of contact person:

Name _____

Mobile no. _____

Desig. _____

E-mail: _____

3. Branch/ Liaison office in Delhi/NCR

Details of contact person:

Name _____

Mobile no. _____

Desig. _____

E-mail: _____

Weekly off day _____

4. Address of Works where Item is being manufactured

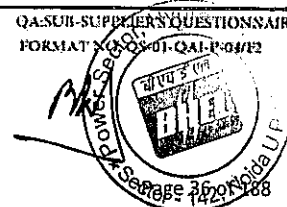
Details of contact person:

Name _____

Mobile no. _____

Desig. _____

E-mail: _____



SUB-SUPPLIER QUESTIONNAIRE
(To be filled in by the Proposed Sub Supplier)

5. Details of Proposed Works:

- a. Year of Establishment of present works : _____
- b. Year of Commencement of Manufacturing at the above works : _____
- c. Details of change in works address in past, if any : _____
- d. Total Area / Covered Area : _____
- e. Details of covered area like no. of sheds, Area of each shed etc. _____
- f. Electric power- Connected load: _____
Electric power- Stand by load & system: _____

6. Annual Turnover & Profit in past three years : _____

7. Do you have in-house Department for:

- a) Design Yes/No
- b) Research & Development Yes/No
- c) Quality control/Inspection Yes/No
- d) After Sales Service Yes/No

8. Shift works per day

One/Two/Three

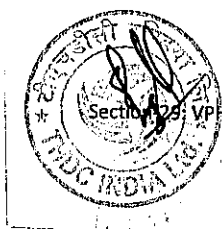
9. Present Manpower Status:

Division Status	Graduate		Diploma	Skilled	Un-Skilled	Remarks
	Technical	Non-Technical				
Design						
Production						
Quality Control/ Inspection						
After Sales Service						

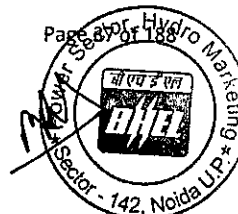
VISHUNAGAD PIPALKOTT HEP (4X111 MW)

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QASUB-SUPPLIER'S QUESTIONNAIRE
FORMAT NO: QS-01-QAI-P-04/F2



Section 128: VPHEP-EM Works-QAI Requirement



SUB-SUPPLIER QUESTIONNAIRE
(To be filled in by the Proposed Sub Supplier)

- a. Organization chart of the proposed works is enclosed as Annexure: _____
 b. Organization chart of QA / QC Deptt. is enclosed as Annexure: _____
 c. List of Qualified Welders with process etc. is enclosed as Annexure: _____
 d. List of Qualified NDT personnel with area of specialization is enclosed as Annexure: _____

10. Brief details of items manufactured:

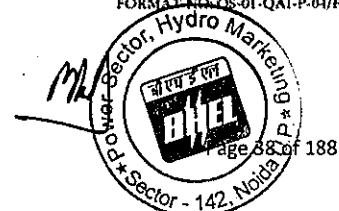
Sl. No.	Item & Material (Type/Size/Rating/Model/ Capacity /Tonnage , as applicable)	Installed Capacity	Annual Production Capacity	Annual Production for last Three years		
				I	II	III

11. Details of foreign Collaboration, if any:

Sl. No.	Product	Name & Address of Collaborator	Collaboration		
			Scope	Year	Valid upto

12. Type Test report for the proposed product (similar or higher rating) if applicable is enclosed as Annexure: _____
 13. Approval / Certification by National / International standards / Accredited agency for the proposed product (if applicable) is enclosed as Annexure: _____
 14. Statutory / mandatory certification for the proposed product (if applicable) is enclosed as Annexure: _____
 15. Supply Experience list of the proposed product (similar or higher rating) is enclosed as Annexure: _____

[List shall include Item description, (Type/Size/Rating/Model/Capacity/Tonnage, as applicable), Customer name, Quantity, Year of Supply and Year of commissioning]



SUB-SUPPLIER QUESTIONNAIRE
(To be filled in by the Proposed Sub Supplier)

16. End User's operational feedback certificate for the proposed product is enclosed as Annexure: _____
17. List of equipment & machinery specific to the proposed product is enclosed as Annexure: _____
(List shall include name of equipment, capacity & nos. etc.)
18. Process Flow Diagram indicating in-house & outsourced process enclosed as Annexure: _____
19. General manufacturing facilities available in-house:

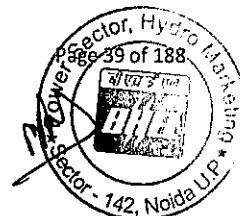
SL No.	Description of machine	Type /Capacity / Size / Rating etc as applicable	Number
a)	Material Handling Mobile Crane Fork Lift Over Head Cranes		
b)	Metal Cutting & Bending		
c)	Casting		
d)	Forging		
e)	Fabrication		
f)	Welding		
g)	Machining		
h)	Heat Treatment		
i)	Surface Cleaning Sand Blasting Shot Blasting Pickling		
j)	Painting		
k)	Metal Coating		

VISHNUGAD PIPALKOTI HEP(XLUMW)

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QA-SUB-SUPPLIER'S QUESTIONNAIRE
FORMAT NO: QS-01-QAI-P-04/F2

Section: VPHEP-EM Works-QAI Requirement



<u>SUB-SUPPLIER QUESTIONNAIRE</u> (To be filled in by the Proposed Sub Supplier)					
l)	Packing				
m)	Other, if any				

20.

a. Inspection & Testing Facilities available in-house:

Sl. No.	Description	Capacity & Nos.	Make & year of Mfg.	Calibration Status	Validity period

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QASUB-SUPP. HRS QUESITONNAIRE
FORMAT 1005-01 QAL-P-004

Hydro
Power Sec
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QAL-P-004

QASUB-SUPP. HRS QUESITONNAIRE
FORMAT 1005-01 QAL-P-004

Hydro
Power Sec
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Sector - 142, Nong

QAL-P-004



SUB-SUPPLIER QUESTIONNAIRE
(To be filled in by the Proposed Sub Supplier)

b. List of Testing & Inspection Facilities outsourced, if any with Source of testing and Description enclosed as Annexure: _____

21. Storage of finished goods (covered / open) : _____

22. List of the source / make with location of major raw material, bought out items and out sourced process enclosed as Annexure: _____

23. Quality management:

23.1 General

23.1.1. Work Instruction for different processes available. (Y/N). _____

If yes, enclose list as Annexure _____

23.1.2. Evaluation system for raw material/bought out item's supplier is available. (Y/N) _____

23.1.3. Records generated during inspection maintained & available for review (Y/N) _____

23.1.4. Statistical quality control techniques used (Y/N) _____

23.1.5. ISO certificate for the works available (Y/N). _____ If yes, enclose copy as Annexure _____

23.2 Corrective action

23.2.1. Specifically confirm whether System for identification & disposition of Non Conformity in the process / product is available. (Y/N) _____

23.2.2. Specifically confirm whether System for Customer complains & their satisfactory disposal is available. (Y/N) _____

23.3. Documentation Control

23.3.1. Procedure available for documentation control (Y/N) _____

23.4. Control of Inspection, Measuring & Testing equipments.

23.4.1. Procedure for calibration of testing & measuring instrument available. (Y/N) _____

24. Any Special Information: _____

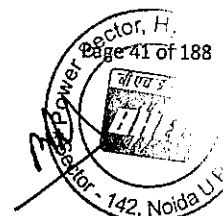
VISHNUGAD PIPALKOTI HEP(4X11 MW)

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QA-SUB-SUPPLIER'S QUESTIONNAIRE
FORMAT NO: QS-01-QAI-P-04/F2



Section-29: VPHEP-EM Works-QAI Requirement



SUB-SUPPLIER QUESTIONNAIRE
(To be filled in by the Proposed Sub Supplier)

26. I CERTIFY THAT THE INFORMATION SUPPLIED HEREIN (INCLUDING ALL PAGES ATTACHED) IS CORRECT TO THE BEST OF MY KNOWLEDGE.

SEAL

M/S. _____
PLACE _____
DATE _____

SIGNATURE _____
NAME _____
DESIGNATION _____
MOBILE NO _____
EMAIL _____

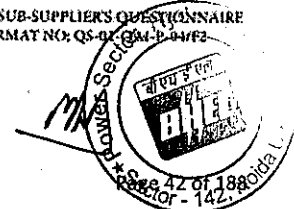
LIST OF ENCLOSURE:

Certification by Main Supplier: Above information have been verified and found in order / minor changes which have been marked and initialed on this form itself / observed the following discrepancies.

Name : _____ Designation : _____ Signature : _____ Date : _____

NOTE :

1. COLUMN SHALL NOT BE LEFT UNFILLED..IN CASE OF NOT APPLICABLE / NOT AVAILABLE, THE SAME SHALL BE INDICATED IN THE PROVIDED SPACE.
2. IN CASE PROVIDED SPACE IS NOT ADEQUATE, INFORMATION SHALL BE PROVIDED AS AN ATTACHMENT.
3. PRODUCT CATALOGUE FOR THE PROPOSED EQUIPMENT/ITEM/PROCESS, IF AVAILABLE, SHALL BE ENCLOSED



B: QUALITY ASSURANCE & INSPECTION REQUIREMENTS OF EM EQUIPMENTS

1. MATERIALS

The construction materials for all equipment shall be of a quality suitable for the purpose of each item and shall be free of all defects. Material types may be changed at the design stage only with the Employer's approval and only if the new materials can be proven to provide at least the same factor of safety for the equipment.

1.1 Castings, Forgings & Plates:

All castings shall be true to pattern, of good finish, and of uniform quality and condition, free from blowholes, porosity, hard spots, shrinkage defects, cracks, or other injurious defects, and shall be satisfactorily cleaned for their intended purpose. The largest fillets compatible with the design shall be incorporated wherever a change in section occurs. The surface of castings, which do not undergo machining, shall be free from foundry irregularities, such as projections, ridges, hollows, honeycombing.

The structure of the casting shall be homogeneous and free from excessive nonmetallic inclusions. An excessive segregation of impurities or alloys at critical points in a casting will be caused for its rejection.

The materials for each kind of casting shall be in accordance with the followings, or approved equal.

Iron Castings ASTM Specification/ equivalent International/ national standard.

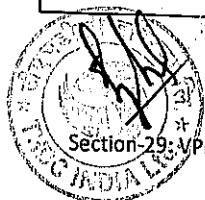
Carbon Steel Castings ASTM Specification/ equivalent International/ national standard.

Stainless Steel Castings ASTM Specification number / equivalent International/national standard and grade, composition, shall be proposed.

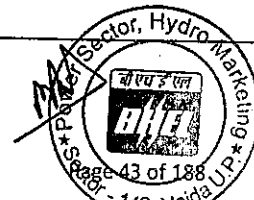
The largest fillets compatible with the design shall be incorporated wherever a change in section occurs. Tool marks or tearing of the metal by the finishing tool will not be permitted on the surface of fillets. Grinding or polishing shall be required to remove such marks if they occur. All finished surfaces of forgings shall be smooth and free from tool marks.

Steel plate used for pressure vessels shall meet ASTM Specification/ equivalent International/national standard.

Stainless steel plates shall be in accordance with ASTM Specification/equivalent International/national standard. The grade, specification number, and chemical composition shall be as per tech. specifications.



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**B: QUALITY ASSURANCE & INSPECTION REQUIREMENTS
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2. TESTS ON MATERIALS

2.1 Non Destructive Testing

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

2.1.1. CASTINGS:

2.1.1. (a) Radiographic examination:

ASTM E 446: minimum quality level 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

2.1.1. (b) Ultrasonic examination:

-ASTM A 609: minimum quality level 2

2.1.1. (c) Magnetic particle examination:

- ASTM E 125: minimum quality levels: type I degree 0, other types degree 1

2.1.1. (d) Dye penetrant examination:

- ASTM E 165: evaluation to be agreed upon at the inspection and the acceptability will be subject to agreement between the Employer's Representative and the Contractor.

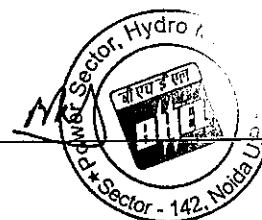
2.1.2. FORGINGS:

2.1.2 (a) Ultrasonic Examination

ASTM A 388: acceptability of any recordable indication shall be at the Employer's Representative's judgment

2.1.2. (b) Magnetic particle examination:

ASTM A 275: evaluation to be agreed upon at the inspection and the acceptability will be subject to agreement between the Employer's Representative and the Contractor.



2.1.3. PLATES :

2.1.3(a) Ultrasonic examination: ASTM A 435

2.2 Mechanical Tests and Chemical Composition

All principal materials, such as plates and sections subject to intermediate and high stresses, main castings and forgings, 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 Employer's Representative. Mill test certificates for chemical composition of the material shall be submitted. Test specimens and sample shall be plainly marked to indicate the material they represent and, if required, shall be properly boxed and prepared for shipment.

3 TEST CERTIFICATES AND REPORTS

3.1. General

The Contractor shall carry out all tests as specified and shall record all test results in a satisfactory manner. Customer hold points shall be witnessed by the Employer together with the Employer's Representative.

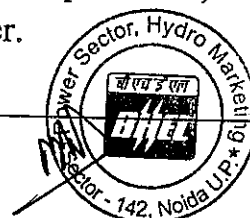
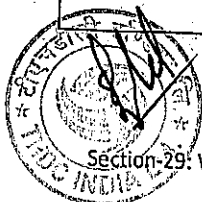
3.2. Certificates

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 standard have been complied with.

4. WORKMANSHIP:

4.1 General

The materials shall be accurately finished and shall be in accordance with the highest current technical Standards. In particular, homologous parts shall be interchangeable with each other.



4.2**Welding**

All welds shall comply in all respect with ASME or EN standards. The welding work shall be done by arc welding and the work shall be free from pinholes, cracks and any other notable defects. The qualification test of welding operation and welders shall be in accordance with the latest edition of Section IX of the ASME Boiler and Pressure Vessel Code or other equivalent standards. Welding rods to be used in hand welding shall be a heavy coated type suitable for welding of all sections.

Plates to be joined by welding shall be accurately cut to size and rolled by pressure to the proper curvature, which shall be continuous from the edge. Flattening in the curvature along the edges with correction by blows will not be allowed. The dimensions and shape of the edges to be joined shall be such as to allow thorough fusion and complete penetration, and the edges of plates shall be properly formed to accommodate the various welding conditions.

The Contractor shall submit for approval the welding procedure, base materials, welding rods and non-destructive tests of welding.

4.3**Welding Equipment at Site:**

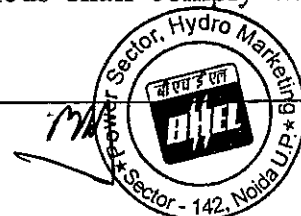
The welding equipment at Site shall include all devices necessary to avoid arc extinguishing and to ensure a steady supply voltage within one tenth of five percent. Voltage shall not be higher than 80 V.

4.4**Electrodes:**

The Contractor shall indicate in all detail drawings the type and size of electrode he proposes to use for shop and/or field welding. The electrodes shall be shipped suitably packed in weatherproof metal boxes and kept inside their box up to their use. Should any box be damaged, the electrodes shall be replaced. The electrodes to be used shall be maintained in a drying oven at a temperature of about 90°C. Electrodes exposed outside for more than four hours shall be returned to the oven.

4.5**Stress Relieving**

All cold rolled plates, with thickness greater than 35 mm and/or 0.8 percent of the rolling diameter, to be welded to each other in the workshop shall be stress relieved after welding and before machining in order to eliminate the internal stresses. In all the other cases, stress relieving shall be made when required by ASME Code for Unfired Pressure Vessels. Stress relieving methods shall comply with ASME Standards.



B: QUALITY ASSURANCE & INSPECTION REQUIREMENTS OF EM EQUIPMENTS

4.6 Non Destructive Testing

4.6.1

The tests that shall be carried out are those indicated in the Technical Requirements. If no indication is given, the welds shall be tested according to the joint efficiency adopted in the calculations, following the indications of ASME Section VIII Table UW12. All welded joints assuring tightness shall be inspected or tested by magnetic particle or dye penetrant. The Contractor shall indicate in the Fabrication and Installation Drawings the type of non-destructive testing to be conducted. The following prescriptions shall apply:

4.6.2.

Radiographic Examination

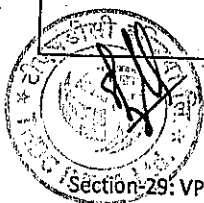
According to ASME Section VIII par. UW-51 and for spot examination according to ASME Section VIII par. UW-52.

4.6.3.

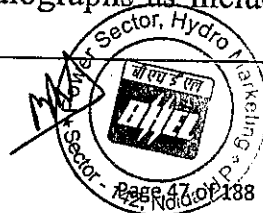
Ultrasonic Examination

According to ASME Section VIII Appendix U. The ultrasonic examination will be considered equivalent to the radiographic examination for the purpose of the weld efficiency factor determination, provided that the following conditions are met:

- All welds with indications exceeding 50% of the reference level shall be radiographed following the prescriptions of ASME Section VIII par. UW-51;
- Not considering the above radiographs, 10% of the welds carried out in the workshop and 20% of the welds carried out at Site shall be radiographed.
- Welds shall be divided into groups, according to the welding procedure and position of the welds, and in agreement with the Employer's Representative. In any case, welds carried out on different materials and/or by different welders or welding machines and/or with electrodes of different quality shall not be considered as pertaining to the same group.
- The influence of thicknesses; castings and weld positions on the grouping shall be agreed with the Employer's Representative. The Employer's Representative will choose the welds and/or the groups on which the radiographic examination shall be carried out. Should a single unacceptable defect be found out, the whole group shall be radiographed, without considering these radiographs as included in the above percentages.



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OF EM EQUIPMENTS**

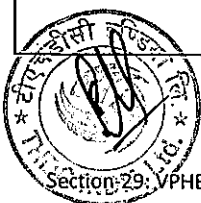
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- Crossing point welds shall be 100% radiographed; also these radiographs are not included in the above percentages. All welds to be radio graphically examined will be countermarked with identification marks appearing in the radiographic film and the marks shall not be removed before the approval of the relevant weld has been given by the Employer's Representative. The Contractor shall submit to the Employer's Representative the radiographic film of all welds to be approved, together with a localisation map of the relevant identification marks. All radiographic films shall become the property of the Employer. Welds performed on automatic resistance butt-welding machine shall undergo an indirect control providing sampling pieces. For each piece, mechanical tests and other tests according to Contractor's practice shall be performed on the welding. In case one welding proves to be defective, the adjacent welds shall be cut out and tested. All defects detected by inspection shall be fully corrected and inspected again until the correction has been approved by the Employer's Representative.

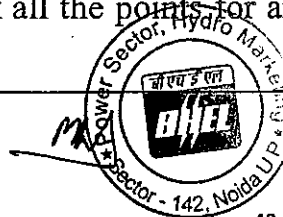
4.6.4

Hydrostatic Testing:

- Hydrostatic testing shall be conducted as per Employer's Technical requirement. Details of the testing procedures and test beds to be used shall be furnished by the Contractor to be approved by Employer's representative. All arrangements for Hydrostatic testing including devices, equipments, facilities etc. shall be at Contractor's account.
- The pipe shells, bends, etc. shall be subjected to hydrostatic test pressure, equal to 1.5 times the design pressure.
- Before applying pressure, the equipment shall be inspected to see that all joints are leak proof and to ensure that all low pressure filling lines and other appurtenances that shall not be subjected to the test pressure, are disconnected.
- After being completely filled with water, the pressure in steel liner assembly or the part to be tested, shall be applied slowly at a uniform rate up to the design pressure for a minimum of 5 minutes or sufficient time to check all the points for any defect / leakage.



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- The pressure is then brought down to 75% of the design pressure and then raised to the test pressure (1.5 times the design pressure) and held for atleast 15 minutes or sufficient time for inspection of plates, all welded joints and connections and all regions around openings.
- All defective welded seams and all defects in steel plates discovered during the hydrostatic pressure test shall be marked and after draining out the water they shall be satisfactorily repaired.
- After repair and radiography, all sections shall again be subjected to a hydrostatic pressure test as above. This procedure shall be repeated till satisfactory results are obtained throughout.

5.

SURFACE PREPARATION AND PAINTING

(Also see Clause No. 16 "Protection and Preservative Shop Coating")

5.1.1.

Shop Treatment:

The surface of steel parts shall be sand blasted. A primer coat of zinc rich epoxy approved by the Design & Engineering shall be applied cold to all surfaces. Machine finished surfaces of the Equipment and the portions to be embedded in concrete shall be adequately protected by rust preventive means.

5.1.2.

After Shop Assembly:

Painted surfaces shall be touched up by sand blasting and complete painting treatment if they have been damaged during transport or handling, and coated with two or three top coats (depending on paint thickness) of bituminous epoxy paint. The total thickness of paint including top coat shall be as specified in tech. specification.

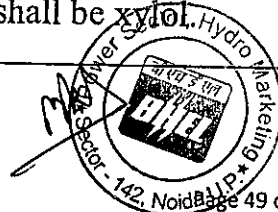
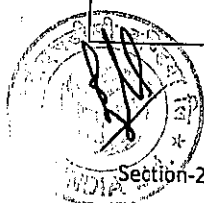
5.2

Spiral Casing/ Draft Tube:

5.2.1.

Surface Preparation:

- Weld spatters, burrs or any other objectionable irregularities shall be carefully removed or repaired by suitable means before cleaning.
- All oil, grease and dirt shall be removed from the surface by the use of clean mineral spirits, xylol or white gasoline followed by wiping with clean wiping materials, except that for surfaces, which require Coal tar coatings, the cleaning solvent shall be xylol.



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- Following the solvent cleaning, the surfaces to be painted (inner surface and outer surfaces exposed to weather) shall be cleaned to base metal to remove all rust, mill scale and other tightly adhering objectionable foreign materials by sand blasting or grit blasting to a uniform finish equivalent to SA 2.5 or as specified in IS: 9954. A clean and dry gypsum and salt free quartz sand having grain size 0.7 to 1.5 mm shall be used for sand blasting. Blast cleaning shall be accomplished with abrasives of such particle shape, hardness and gradation as to effectively clean the metal and have roughened surface suitable for tenacious adhesion of subsequent coating. The primer coat of paint shall be applied on surfaces cleaned as above, as soon as possible after such preparation has been completed, but in any case prior to deterioration of the prepared surface.
- Any grit or dust remaining from the cleaning operation shall be completely removed from the surface by brushing, air blowing, suction or other effective means before the surfaces are accepted for painting.
- In the event of rust formation or when the surfaces become otherwise contaminated in the interval between cleaning and painting, re-cleaning shall be required to be done.

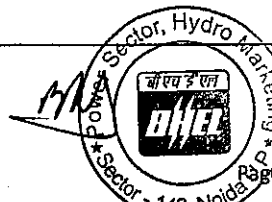
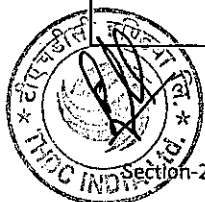
6.

LUBRICATION

All components in movement shall be duly and efficaciously lubricated. Greasing or lubricating points shall be grouped for all equipment in easily accessible positions. Pressure gauges and level indicators shall be installed in a noticeable place to acknowledge a sudden drop in level or pressure and prevent any damage that may occur.

Dipsticks, leakage drip plates, lubricant sight glasses shall be installed throughout the Plant. All the lubrication equipment shall be tested, before placing into service, at a pressure of 1.5 times the maximum operating one. The Contractor shall entrust a lubrication schedule for the Equipment, showing the recommended frequency of application and types and grades of required lubricants. The recommended lubricants shall be approved by the Employer's Representative before requiring their supply. As a general rule lubricants of Indian manufacture shall be preferred.

Type of oil and grease shall be reduced to a minimum so as to facilitate



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maintenance, and shall be available in the local market. After the Employer's Representative's approval, the Contractor shall supply all first filling oil and grease. With the first filling it is intended the 125% of the quantity necessary for the operation of the equipment.

7. TESTS

Shop Tests:

The following tests and inspections shall be carried out:

- Visual inspection of embedded parts, EOT Cranes
- All welds shall be inspected;
- All embedded parts shall be checked for dimensions straightness and roughness at the complete trail assembly position;

** For EOT Crane also refer "QA Requirement-Mechanical Equipment Material Procurement & Manufacture)".*

The Employer or his Representative may attend to some or all tests and inspections.

8. MANDATORY/ RECOMMENDED SPARE PARTS:

All the spare parts furnished by the contractor shall be interchangeable and shall be made of same material & workmanship as the corresponding part of the equipment furnished.

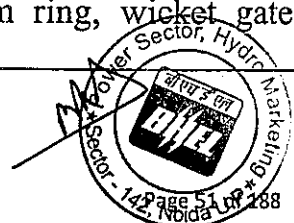
9. SHOP ASSEMBLY AND TESTS

9.1 The sub-assemblies and parts shall be assembled and tested in shop to ensure that parts are correctly fabricated and properly aligned. Prior to shop assembly and testing the contractor shall submit for review an outline of the procedures and tests, which are planned to be performed to demonstrate the fulfillment of the requirement of the specifications. The cost of carrying out the tests shall be borne by the contractor. However, shop assembly testing and test of bought out items would be carried out at the instruction and discretion of the OWNER or his authorized representative.

9.2 All parts of assemblies like of Draft Tube, Draft Tube Elbow Liners, Draft Tube Cones, Spiral casings, Distributor/ Guide Apparatus and appurtenances including head cover, bottom ring, wicket gates and



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operating rings, Guide Bearing and Shaft Seals etc. shall be trial assembled at works of manufacturer making complete assembly of the item so as to allow for adjustment of various dimensions to make them conform to the designed dimensions, fits, tolerances, surfaces finishing, clearances etc. (if required dummies shall be used by the manufacturer for trial assembly).

Parts of above assemblies shall be match-marked for their relative position in order to facilitate their assembly as per tech. requirement in the field before despatch.

9.3

PULLEY ASSEMBLY

Pulleys, shafts, shafts brackets bushing/bearing assembly shall be carried out in the shop and checked for dimensional accuracy, fits and tolerances of mating components.

10.

UNIT MARKING, MATCH MAKING AND TRANSPORTATION DESIGNATION

Each parts of assembly like Elbow Liners, Draft Tube Cones, parts of Guide Apparatus etc. which are to be transported as a separate piece, shall be marked to show the unit of which it is a part and match marked to show its relative position in the unit to facilitate assembly in the field. Unit marks and match shall be made with heavy steel stamps and paint.

Each piece, sub-assembly or package transported separately shall be labeled or tagged with transport consisting of the specification number, the marks number of such pieces and number of parts grouped of such sub-assemblies contained in package.

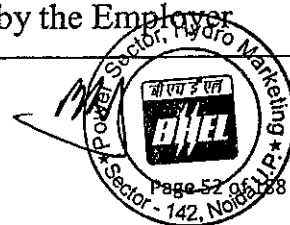
11.

RATING PLATES, NAME PLATES & LABELS

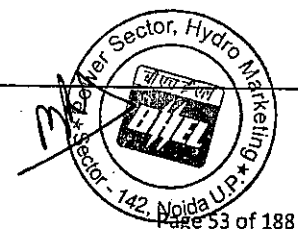
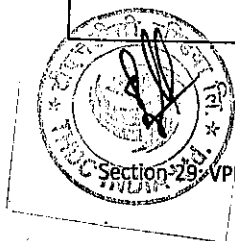
- 11.1. Each main and auxiliary item of plant shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which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



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- 11.2. Each item of plant shall be provided with name-plate or label designating the service of the particular equipment. The inscriptions shall be approved by the Employer or as detailed in appropriate section of the technical specifications.
- 11.3. Such name-plates or labels shall be of white non hygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breaker, starter, etc. of transparent plastic material with suitably coloured lettering engraved on the back. The name plates shall be suitably fixed on both front and rear sides.
- 11.4. All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.
- 11.5. Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated name plate or label with engraving filled with enamel. The name plate for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.
- 11.6. Hanger support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable support shall also have stamped upon it the designed hot and cold load which it is intended to support. Suitable scale shall also be provided to indicate load on support/hanger.
- 11.7. Valves and strainers shall be identified by Employer's tag number of a metal tab permanent attached to non pressure parts such as the yoke by a stainless steel wire. The direction of flow shall also be marked on the body.
- 11.8. Safety and relief valves shall be provided with the following:
- a) Manufacturer's identification.
 - b) Nominal inlet and outlet sizes in mm.
 - c) Set pressure in Kg/cm^2 (abs.).



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- 11.9. All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with colored phase plates to clearly identify the phase of the system.

12. TOOLS AND TACKLES

The Contractor shall supply with the equipment one complete set of all special tools and tackles and other instruments required and other instruments for the erection, assembly, disassembly and proper maintenance of the plant and equipment and system (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment; checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder along with the offer.

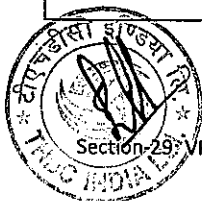
The price of each tool/tackles shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Contractor shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Contractor should bring his own tools and tackles. In case these tools and tackles are used by the Contractor during erection, commissioning or initial operation the same shall be refurbished repaired/replaced as required to the satisfaction of the Employer before handing over to the Employer. All the tools and tackles shall be of reputed make acceptable to the Employer.

13. WELDING

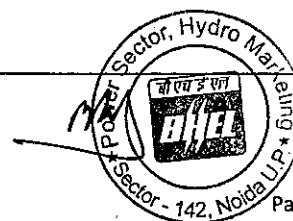
- 13.1. If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be performed by other the requirements shall be submitted to the Employer in advance of commencement of erection work.

14. COLOUR CODE FOR ALL EQUIPMENTS/ PIPINGS/ PIPE SERVICES

All equipment/ piping/ pipe services are to be painted by the Contractor in accordance with color and coding scheme given in Employer's Requirement.



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15. SURFACE TREATMENT AND COATINGS

Please refer Annexure-‘A’ of this sub-section.

16. PROTECTION AND PRESERVATIVE SHOP COATING

16.1. Protection

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner. All primers / paints / coatings shall take into account the hot humid, corrosive and alkaline, subsoil or over ground environment as the case may be.

16.2. Preservative Shop Coating

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated before hand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish – painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer.

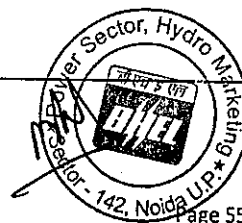
16.2.1. Transformers and other electrical equipments if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel.

16.2.2. The finish colors shall be as per manufacture’s standard, to be selected, specified and approved by the Employer.

16.2.3. Shop primer for all steel surfaces shall be selected by the Contractor, after obtaining specific approval of the Employer including the quality of primer proposed to be applied.



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- 16.2.4 Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degree Celsius shall be selected by the contractor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degree Celsius and such primer shall also be subject to the approval of the Employer.
- 16.2.5 All other steel surfaces which are not to be painted shall be coated with suitable rust preventive compound subject to the approval of the Employer.
- 16.2.6 All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Employer. Lube oil piping of carbon steel be pickled.

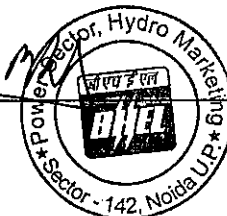
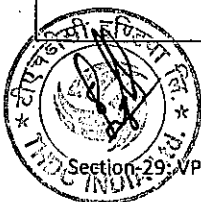
17. PACKING & TRANSPORTATION

All the equipments shall be carefully packed in robust packing-suitable for long time transportation by sea, rail and land. The equipments shall be completely protected against moisture and rust from salt water and rain. The same precaution and care shall be taken for the Equipment (including components), which cannot be packed or crafted.

The spare parts shall be packed and crated firmly to withstand storage for a long time, and those in need of rust preventive treatment shall be so treated.

The spare parts shall be packed separately from other articles and absolute care shall be taken to prevent spare parts being packed or crated in the same box or crate with the Equipment or the installation materials. Packages of spare parts shall carry notation, which clearly indicated that the contents are spare parts and shall be accompanied by a list of contents, which sets forth directions for storing.

The contractor shall take into account the limitations if any for port handling or road load bearing capacities.



Annexure-‘A’**Quality Assurance & Inspection Requirements of EM Equipments:
General Tech. Requirement****SURFACE TREATMENT AND COATINGS**

1.00.0. The present specifications apply to equipment and spare part surface coating. They define surface coating, the types of recommended coating, and the associated guarantees. In any case, the Contractor shall submit to the Employer his coating schemes.

1.01.0. CORROSION PROTECTION:

The Contractor shall take all necessary favorable measures to protect equipment from all abnormal corrosion taking into account project specific risks.

In particular, the Contractor shall choose the materials most suited to this project and shall submit a modification request to the Employer when the materials indicated in the specifications are considered unable to guarantee its behaviour against corrosion.

1.02.0. Equipment in Contact with Reservoir Water

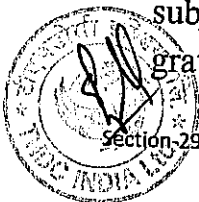
For all equipment on the water conveyance circuit (trash racks, valves, pipes, pump turbines instruments), the use of uncoated carbon steel is prohibited, even where corrosion allowance is planned. If he considers it necessary, the Contractor may apply stainless steel cladding to some carbon steel parts, or manufacture these parts in solid stainless steel.

If maintenance is unsure because of peculiar equipment arrangement, or if the equipment cannot easily be shutdown, the Contractor may submit to the Employer, alternative corrosion protection methods, so that vulnerable surfaces can be protected effectively.

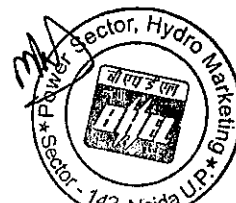
1.02.01. Outdoor Exposed Equipment

Among these equipment can be distinguished:

- those figuring as the subject of a particular specification, and for which the nature of materials and corrosion protection is clearly defined,
- those which, unlike the above, are not functional in nature and so are not subject to the same attention regarding problems of corrosion: parapets, gratings, lighting poles, etc.



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Even this second category of equipment shall be subject to particular attention with regard to choice of materials and corrosion protection.

In general, attention shall be paid to taking constructive measures or acquiring standard equipment, whatever the function, to avoid any water build-up. Such constructive measures are, for example:

- for constructive using structural sections (dam gates, stoplogs), that all horizontal sheet metal sections have drainage holes at regular intervals;
- for auxiliary structures, embedding holes shall be completely filled with concrete, taking care to avoid any break in corrosion protection where concrete is exposed to the air.

2.00.00. GENERAL:

The Contractor shall provide a complete and reliable surface treatment of the equipment furnished for corrosion protection.

Surface protection shall comprise:

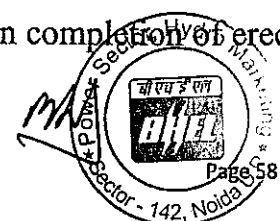
- a surface preparation phase with mechanical cleaning, grit blasting or chemical cleaning,
- a surface treatment phase with either metallizing and application of one or two priming coats suited to the type of metal surface, or application of priming coat,
- an application phase with several coatings of products, including final colored coat.

Surface protection shall be performed either in the Contractor's shops or on site, as per Employer's Requirement (ER), with the necessary precautions taken.

Finishing touch-ups shall be performed on site upon completion of erection.



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3.00.00. SURFACE TREATMENT:

All surfaces to be coated shall first be mechanically or chemically cleaned.

3.01.00. Mechanical Cleaning:

Surfaces shall be mechanically cleaned using one of the following methods:

- shot-blasting or grit blasting,
- Scraping, stripping, mechanical brushing.

3.01.01. Shot-blasting or Grit blasting:

If mineral abrasives are used, they shall be selected in compliance with the prevailing regulations concerning workers' safety.

The required care levels of surface states after cleaning are defined by the illustrations in standard ISO 8501, or equivalent. The required care shall be as follows:

- preparation of steel surfaces to be imbedded set in concrete = Level 1,
- preparation of steel surfaces to receive definitive protection = Level 2.5,
- preparation of steel surfaces to receive metallized protection = Level 3.

The roughness of the cleaned surfaces shall be $Ra = 12.5 \mu m$, except for surfaces that shall be metalized later, for which the roughness shall be $Ra = 6.3 \mu m$.

3.01.02. Scraping, Stripping, Mechanical Brushing:

This type of cleaning shall concern:

- Parts to be set in concrete, which shall not be coated.

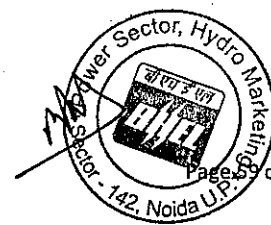
These parts shall be brushed immediately prior to concreting.

- Repair of defective surface coating. In this case, cleaning by scraping, stripping or brushing shall only be performed if shot-blasting or grit blasting is impossible.

The required care shall be as follows:

- St 2 for surfaces which shall subsequently receive a definitive coating.
- St1 for surfaces to be set in concrete with no surface protection.

After cleaning, all surfaces shall be thoroughly dusted.



3.01.03. Surface Protection Repair:

Before surface protection is repaired, the old protection shall be partially or entirely removed. A new defects liability period shall start as soon as the zone in question has been repaired.

The old coating shall be completely removed by shot-blasting or grit blasting, in compliance with the specifications in 3.01.01.

If this process is impossible, the old coating shall be removed by scraping, stripping or mechanical brushing, in compliance with the specifications in 3.01.02.

4.00.00. CHEMICAL CLEANING:

All traces of pollution shall be removed with solvents (degreasing, neutralisation). The surfaces shall then be rinsed and dried (with special cleaning paper).

The Contractor shall submit, for the Employer's approval, a list with the characteristics of the solvents that he intends to use.

5.00.00. SURFACE TREATMENT:

Immediately after surface preparation, the Contractor shall employ one of the following three surface treatment processes:

6.00.00. METALLIZING:

Metalizing shall be performed within 2 hours after preparation.

The chemical composition of the metal used shall be: 85 % Zinc - 15 % Aluminum. The thickness shall be 120 μm .

Application shall be by spray gun in compliance with ISO standards R 2053.

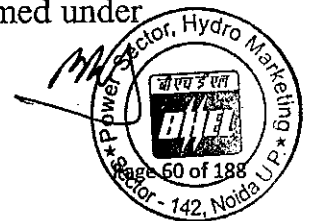
After metalizing, pores shall be plugged by applying a wash primer, or, if the equipment is intended for immersion, by applying a thin coat of zinc epoxy (max. 20 μm).

7.00.00. HOT GALVANIZING:

This coating performed by quenching shall have the following characteristics:

- minimum unit mass : 5g/dm²,
- average thickness : 70 μm

This process shall be used when metalizing cannot be performed under satisfactory conditions.



8.00.00. PRIMARY COAT APPLICATION:

This coating shall have the following characteristics:

- product : zinc epoxy coat,
- thickness : minimum 40 μm .

9.00.00. APPLICATION FOR THE PROTECTION:

The Contractor shall carefully control relative humidity and temperature before and during applying any coating. In any case, the relative humidity shall not exceed 80 %.

All traces of condensation shall be eliminated before protection is applied. If the relative humidity remain between 50 and 80%, the first coat shall be applied four (4) hours after the surface preparation.

The undercoats or finish coats shall be applied in compliance with the drying time required between each application.

10.00.00. TOUCH-UPS:

If more than 20 % of the total surface area of a given zone shall be touched-up, the Contractor shall replace the surface treatment over the entire surface.

11.00.00. PROTECTION OF SURROUNDING SURFACES:

The Contractor shall take every measure to protect the surrounding equipment and surfaces from product spattering, and from any damage caused by the surface preparation that he performs.

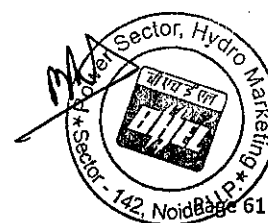
Equipment or surfaces that are soiled or deteriorated in spite of these measures shall be repaired or cleaned, or if this is impossible, replaced at the Contractor's expense.

12.00.00. CARBON STEEL – STAINLESS STEEL CONNECTION:

When carbon steel and stainless steel parts are connected, the surface coating shall be prolonged by 50 cm on the stainless steel part.



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13.00.00. TYPES OF COATING:

The coatings to be applied, except when expressly stipulated otherwise in the equipment specifications, shall be defined as follows:

13.01.00. CARBON STEEL SURFACES IN CONTACT WITH WATER:

System chosen	Thickness
1 zinc epoxy priming coat	40 μ m
2 or 3 coats of epoxy-coal pitch finishing paint	2 x 225 or 3 x 150 μ m

The systems minimum thickness shall be 450 μ m.

The complete protection shall be applied in the shop, except when expressly waived by the Employer, and on site intervention shall be limited to touch-ups.

13.02.00. CARBON STEEL SURFACES IN CONTACT WITH AIR AND INSTALLED OUTSIDE:

System chosen	Thickness
1 epoxy priming coat	40 μ m
2 or 3 coats of epoxy-coal pitch finishing paint	2 x 225 or 3 x 150 μ m

The systems minimum thickness shall be 450 μ m.

The complete protection shall be applied in the shop, except when expressly waived by the Employer, and on site intervention shall be limited to touch-ups.

13.03.00. CARBON STEEL SURFACES UNDER COVER THAT STILL RISK CONDENSATION:

System chosen	Thickness
1 epoxy priming coat	40 μ m
2 coats of colored solvent epoxy pitch	2 x 150 μ m

The systems minimum thickness shall be 300 μ m.

The complete protection shall be applied in the shop, except when expressly waived by the Employer, and on site intervention shall be limited to touch-ups.



13.04.00. CARBON STEEL SURFACES UNDER COVER WITH NO RISK OF CONDENSATION:

System chosen	Thickness
• Zinc epoxy priming coat	50 μm
• 2 coats of colored solvent epoxy pitch	2 x 100 μm

The systems minimum thickness shall be 200 μm .

The complete protection shall be applied in the shop, except when expressly waived by the Employer, and on site intervention shall be limited to touch-ups.

13.05.00. CARBON STEEL SURFACES IN CONTACT WITH OIL:

System chosen	Minimum thickness
• 2 coats of epoxy-polyamide paint containing aluminum	2 x 75 μm minimum

The contractor shall ensure that the paint chosen is compatible with the oil in contact.

The complete protection shall be applied in the shop.

13.06.00. TEMPORARY PROTECTION OF THE GROOVES:

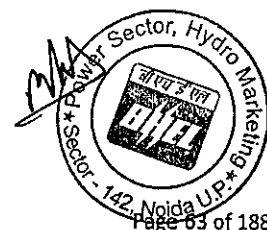
The grooves, along with an area from 100 to 150 mm on either side of them, shall receive a temporary protective coating, according to the following system:

System chosen	Minimum thickness
• 1 coat of weldable epoxy-zinc paint	40 μm

The complete protection shall be applied in the workshop.



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13.07.00. TEMPORARY PROTECTION FOR MACHINED SURFACE:

The surfaces shall be degreased, rinsed and dried before application of the temporary protective coatings.

System chosen	Minimum thickness
• 2 coats for oxidizing surface	2 x 35 μ m
• 1 coat for non-oxidizing surface	1 x 35 μ m

The protection shall be applied in the shop and eliminated on site before erection, using a rag impregnated with a solvent compatible with the materials temporary protected.

13.08.00. CONDENSATION PROTECTION:

The Employer and Contractor shall mutually agree on the products to be used.

13.09.00. SPARE PARTS:

The spare parts' surface coating shall be applied in compliance with the present specifications.

All temporary surface protections (until the spare parts are used) shall be designed to last for minimum 15 years/ or the period of storage of the parts specified in the ER.

13.10.00. COLOR OF THE FINISH COAT:

The Employer shall define the color of the finish coat.

14.00.00. PROTECTION THICKNESS:

Protection thickness shall be checked in compliance with the following specifications:

14.01.00. Number of Measurement Points :

The number of measurement points is defined in the following table:

Size of the surface to be tested (reference zone, in m ² or in linear meter)			Number of measuring points recommended		
< 10			10	to	20
10	to	100	20	to	50
100	to	1000	50	to	100
1000	to	10000	100		200



14.02.00. Tolerance on System Minimum Thickness:

Spot measurements less than the minimum thickness shall be accepted if both following conditions are fulfilled:

- the average of all the measurements performed on the reference zone is equal to or greater than the required minimum value, and
- no measurement point is less than 80% of the required minimum value.

In case of non-compliance with the criteria listed here above, the Contractor shall be obliged to touch up surface protection, either locally or completely.

The touch-up procedure shall be submitted to the Employer.

15.00.00. PRODUCT CHARACTERISTICS DATA SHEET:

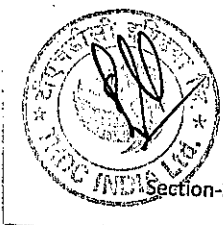
For each product, the Contractor shall provide a characteristics data sheet specifying:

- the manufacturer's references,
- product characteristics,
- application conditions.

The Contractor shall submit a model data sheet to the Employer. This sheet shall then be used for all surface protection works.

16.00.00. PAINTING/ COATING QUALITY CONTROL SHEET:

During coating operations, the Contractor shall fill out the quality control sheet agreed upon by the Employer and the Contractor.



Section-29: VPHEP-EM Works-QAI Requirement



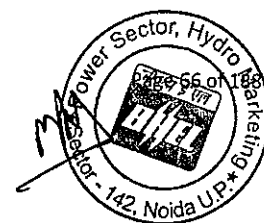
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QA&I: Vishnugad-Pipalkoti HEP (4x111 MW)

Electrical Works

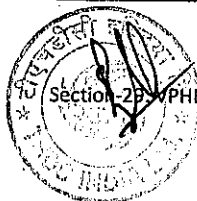


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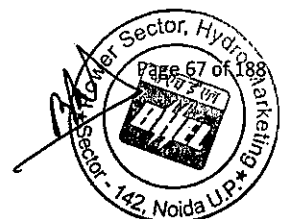


QA & I REQUIREMENTS: ELECTRICAL WORKS

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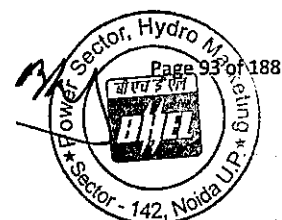
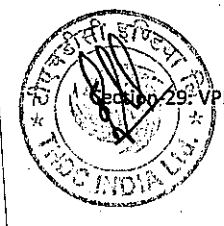
E8. L.T POWER CABLES (1.1 KV PVC & XLPE) (Pg. 1 of 3)

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Attributes / Characteristics	Item / Components / Sub System Assembly	Make, Rating, Type & TC	Dimension/surface finish	Mechanical Properties	Chemical Composition	Electrical Properties	Spark Test	Hot set test (XLPE)	Lay length / Sequence	Armour coverage, Cross over, looseness, Gap between two armour wire/strip	Sequential marking/surface finish /cable length	Tensile strength, elongation before & after ageing of insulation & outer sheath	Thermal Stability of insulation and outer sheath *	Anti termite treatment on wooden drums	Constructional / requirement as per THDC Spec.	Routine and acceptance test as per Relevant Standard and THDC specification	FRLS Test
Aluminum (IS-8130)		Y	Y	Y	Y	Y											
PVC Compound (IS-5831)		Y		Y		Y						Y					
XLPE Compound (IS-7098 Part-I)		Y		Y		Y		Y				Y					
FRLS PVC Compound (IS-5831)		Y		Y								Y					
ASTM-D-2843/ ASTM-D-2863 IEC-754 Part-I																	
Armour wire/strip (IS-3975)		Y	Y	Y													
Insulated Core			Y				Y	Y					Y				
Laid up core			Y						Y								
PVC Inner sheath			Y														
Armouring			Y							Y							
Outer sheath			Y								Y	Y	Y				Y
Finish cable (IS-1554 & 7098 - Part-1) ASTM-D-2843/ IS 10810 (Part- - 58) IEC-754 Part-I Swedish Chimney SS 4241475 for (F3 category) Flammability test IEC-332 Part -3 Cat-B		Y	Y							Y	Y	Y	Y		Y	Y	Y
Wooden drum (IS-10418) / Steel drum			Y											Y			

Note:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and procedure along with relevant supporting documents during QP finalization for all the items.
2. All major Bought Out Items will be subject to Owner's approval.
3. Any other tests mentioned in the equipment specification are also to be carried out.
4. The codes and standards mentioned in equipment specification is governing.



ROUTINE TESTS :

Routine tests shall be carried out on each drum of finished cables for all types & sizes.

Following shall constitute routine tests:

	Conductor Resistance test
	High voltage test at room temperature

ACCEPTANCE TESTS:

Following Acceptance tests shall be carried out for each type and size of the cables on the cable drums selected at random as per sampling plan mentioned in IS: 1554 Part 1 & IS 7098 Part-I

A) For Conductor

- | | | |
|----|-----------------|------------------------------|
| 1) | Annealing test | For copper conductor only |
| 2) | Tensile test | For aluminium conductor only |
| 3) | Wrapping test | For aluminium conductor only |
| 4) | Resistance test | |

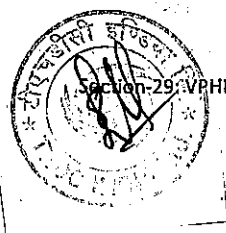
B) For Armour Wires / Formed Wires (If applicable)

- | | | |
|----|----------------------------|-----------------------------------|
| 1) | Measurement of Dimensions | |
| 2) | Tensile Tests | |
| 3) | Elongation Test | |
| 4) | Torsion Test | For Round wires only |
| 5) | Wrapping Test | |
| 6) | Resistance Test | |
| 7) | Mass of Zinc coating test | For G S wires / Formed wires only |
| 8) | Uniformity of Zinc coating | For G S wires / Formed wires only |
| 9) | Adhesion test | For G S wires / Formed wires only |

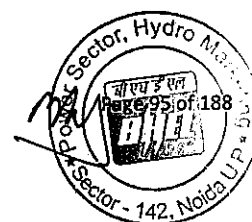
Freedom from defects

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E8. L.T POWER CABLES (1.1 KV PVC & XLPE) CONTD. (Pg. 3 of 3)	
C)	For PVC / XLPE insulation & PVC Sheath
1)	Test for thickness
2)	Hot set test For XLPE insulation only
3)	Tensile strength & Elongation before ageing
D)	For completed cables
1)	Insulation resistance test (Volume resistivity method)
2)	High voltage test at room temperature
E)	Following tests shall be carried out and only one sample shall be taken from each offered lot of all sizes for these tests:-
1)	Tensile strength & elongation after ageing on PVC / XLPE insulation and PVC outer sheath
2)	Thermal stability test on PVC insulation and outer sheath
3)	Oxygen index test on outer sheath
4)	Smoke density rating test on outer sheath as per ASTM -D 2843
5)	Acid gas generation test on outer sheath as per IEC - 754 (Part 1)
6)	Flammability test as per IEC-332 - Part- 3 (Category- B) on completed cable
7)	Fire resistance test as per SS 4241475 (F3 Category) on completed cable
F)	Following tests shall be carried on one length of each size of offered lot:
1)	Surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires



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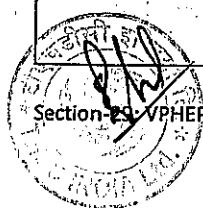
E9. L.T CONTROL CABLES (1.1 KV PVC)

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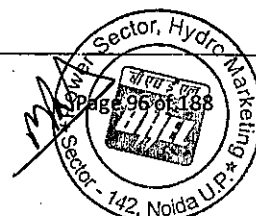
Item / Components / Sub System Assembly	Attributes / Characteristics														FRLS Test
	Make, Type, Rating, T.C	Dimension/surface finish	Mechanical Properties	Chemical Composition	Electrical Properties	Spark Test	Lay length/Sequence	Armour coverage, cross over, looseness, gap between two armour wire	Sequential marking/surface finish/cable length	Tensile strength, elongation before & after ageing of insulation & outer sheath	Thermal stability of insulation and outer sheath	Anti termite treatment on wooden drums	Constructional feature as per THDC Spec.	Routine & Acceptance test as per relevant standard & page 2 & 3 of this table	
Copper Conductor (IS-8130)	Y	Y	Y	Y	Y										
PVC Compound (IS-5831)	Y		Y		Y					Y					
FRLS PVC Compound IS-5831 ASTM-D-2843/ IS 10810 (Part-58) IEC-754 Part-1	Y		Y							Y					Y
Armour wire/strip (IS-3975)	Y	Y	Y												
Insulated Core		Y				Y	Y				Y				
Laid up core		Y					Y								
PVC Inner sheath		Y													
Armouring		Y						Y							
Outer sheath		Y							Y	Y	Y				Y
Finish cable (IS-1554- 1) ASTM-D-2843/ IS 10810 (Part-58) IEC-754 Part-1 Swedish Chimney: SEN SS 424-1475 (F3 category) Flammability test IEC-332 Part-3 Cat-B	Y	Y						Y	Y	Y	Y		Y	Y	Y
Wooden drum (IS : 10418) / Steel drum		Y										Y			

Note:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and procedure along with relevant supporting documents during QP finalization for all the items.
2. All major Bought Out Items will be subject to Owner's approval.
3. Any other tests mentioned in the equipment specification are also to be carried out.
4. The codes and standards mentioned in equipment specification is governing.



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E9. L.T CONTROL CABLES (1.1 KV PVC)

(Pg. 2 of 3)

ROUTINE TESTS

Routine tests shall be carried out on each drum of finished cables for all types & sizes.

Following shall constitute routine tests:

Conductor Resistance test

High voltage test at room temperature

ACCEPTANCE TESTS

Following Acceptance tests shall be carried out for each type and size of the cables on the cable drums selected at random as per sampling plan mentioned in IS: 1554 Part 1

A) For Conductor

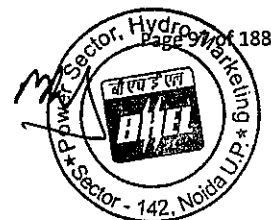
1. Annealing test For copper conductor only
2. Resistance test

B) For Armour Wires / Formed Wires (If applicable)

1. Measurement of Dimensions
2. Tensile Tests
3. Elongation Test
4. Torsion Test For Round wires only
5. Wrapping Test
6. Resistance Test
7. Mass of Zinc coating test For G S wires / Formed wires only
8. Uniformity of Zinc coating For G S wires / Formed wires only
9. Adhesion test For G S wires / Formed wires only
10. Freedom from defects



Section-29: VPHEP-EM Works-QAI Requirement



E9. L.T CONTROL CABLES (1.1 KV PVC)

(Pg. 3 of 3)

- C) For PVC insulation & PVC Sheath**
1. Test for thickness
 2. Tensile strength & Elongation before ageing
- D) For completed cables**
1. Insulation resistance test (Volume resistivity method)
 2. High voltage test at room temperature
- E) Following tests shall be carried out and only one sample shall be taken from each offered lot of all sizes for these tests:-**
1. Tensile strength & elongation after ageing on PVC insulation and PVC outer sheath
 2. Thermal stability test on PVC insulation and outer sheath
 3. Oxygen index test on outer sheath
 4. Smoke density rating test on outer sheath as per ASTM –D 2843
 5. Acid gas generation test on outer sheath as per IEC – 754 (Part 1)
 6. Flammability test as per IEC-332 - Part- 3 (Category- B) on completed cable
 7. Fire resistance test as per SS 4241475 (F3 Category) on completed cable
- F) Following tests shall be carried on one length of each size of offered lot:**
- 1) Surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires

E.11. INDUCTION MOTOR & SYNCHRONOUS MACHINE

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(Pg 1 of 2)

TESTS/CHECKS TEMS/COMPONENTS	Visual	Dimensional	Make/Type/Rating/TC/General Physical Inspection	Mech/ Chem. Properties	NDT /DP/MPI/UT	Metallographic	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment
Plates for stator frame, end shield, spider etc.	Y	Y	Y	Y					Y
Shaft	Y	Y	Y	Y	Y	Y			Y
Magnetic Material	Y	Y	Y	Y	Y		Y		
Rotor Copper/Aluminum	Y	Y	Y	Y		Y	Y		Y
Stator copper	Y	Y	Y	Y			Y		Y
SC Ring	Y	Y	Y	Y	Y	Y	Y	Y	Y
Insulating Material	Y		Y	Y			Y		
Tubes for Cooler	Y	Y	Y	Y	Y				Y
Sleeve Bearing	Y	Y	Y	Y	Y				Y
Stator/Rotor, Exciter Coils	Y	Y	Y				Y	Y	
Castings, stator frame, terminal box and bearing housing etc.	Y	Y	Y	Y	Y			Y	
Fabrication & machining of stator, rotor, terminal box	Y	Y			Y				Y
Wound stator	Y	Y					Y	Y	
Wound Exciter	Y	Y					Y	Y	
Rotor complete	Y	Y					Y		
Exciter, Stator, Rotor, Terminal Box assembly	Y	Y					Y		
Accessories, RTD, BTD,CT, Brushes, Diodes,Space heater, antifriction bearing, cable glands, lugs, gaskets etc.	Y	Y	Y						
Motor (IS 325 / 4722/ 9283)	Y	Y	Y						

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E11. INDUCTION MOTOR & SYNCHRONOUS MACHINE

(Pg 2 of 2)

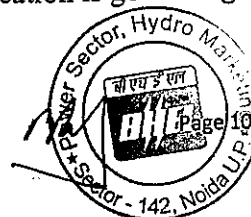
TESTS/CHECKS ITEMS/COMPONENTS	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	All tests as per IS-325/IS-4722 / 9283	Vibration	Over speed	Tan delta, shaft voltage & polarization index test
Plates for stator frame, end shield, spider etc.									
Shaft									
Magnetic Material	Y		Y						
Rotor Copper/Aluminum									
Stator copper			Y						
SC Ring									
Insulating Material			Y						
Tubes for Cooler		Y							
Sleeve Bearing		Y							
Stator/Rotor, Exciter Coils									
Castings, stator frame, terminal box and bearing housing etc.									
Fabrication & machining of stator, rotor, terminal box									
Wound stator									
Wound Exciter									
Rotor complete				Y	Y				
Exciter, Stator, Rotor, Terminal Box assembly									
Accessories, RTD, BTD, CT, Brushes, Diodes, Space heater, antifriction bearing, cable glands, lugs, gaskets etc.									
Motor (IS 325 / 4722 / 9283)						Y	Y	Y	YI

Note:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and procedure along with relevant supporting documents during QP finalization for all the items.
2. All major Bought Out Items will be subject to Owner's approval.
3. Any other tests mentioned in the equipment specification are also to be carried out.
4. The codes and standards mentioned in equipment specification is governing.



Section-29: VPHEP-EM Works-QAI Requirement



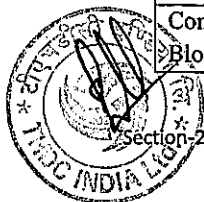
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LT SWITCHGEAR

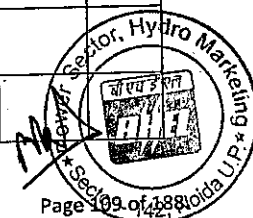
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(MCC, PCC, ACDB, DCDB, FUSE BOARDS, LOCAL PUSH BUTTON STATION, LOCAL MOTOR STARTERS)

ATTRIBUTES / CHARACTERISTICS →	ITEMS/ COMPONENTS/ SUB SYSTEM ASSEMBLY ↓	Make, Model, Type, Rating & TC	Dimensions & Finish	Electrical properties	Mechanical Properties	Chemical properties	Functional & Operational Features as per THDC Spec.	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint Shade, Adhesion, Thickness & Finish	Functional Checks	Milli-volt drop Test	IR - HV - IR Test	Degree of Protection Routine test as per THDC spec	All Routine tests as per THDC spec. & relevant std.
	Sheet Steel (IS : 513)	Y	Y		Y	Y		Y							
	Aluminum Bus bar Material (IS : 5082)	Y	Y	Y	Y	Y		Y							
	Copper Bus bar Material (IS : 613)	Y	Y	Y	Y	Y		Y							
	Support Insulator	Y	Y	Y	Y			Y							
	Air Circuit Breaker (IS : 13947)	Y	Y				Y	Y			Y	Y			Y
	Energy Meters (IS : 13010, 13779)	Y	Y				Y	Y			Y				Y
	Power & Aux. Contactors (IS : 13947)	Y	Y				Y	Y			Y				
	Protection & Aux. Relays	Y	Y				Y	Y			Y				Y
	Control & Selector Switches (IS : 13947)	Y	Y				Y	Y			Y				
	CT's & PT's (IS 2705 / 3156)	Y	Y					Y							Y
	MCCB (IS : 13947)	Y	Y					Y			Y				
	Indicating Meters (IS : 1248)	Y	Y				Y	Y			Y				Y
	Indicating Lamps (IS : 13947)	Y	Y				Y	Y			Y				
	Air Break Switches (IS : 13947)	Y	Y				Y	Y			Y				
	Control Terminal Blocks	Y	Y				Y	Y							



Section-29: VPHEP-EM Works-QAI Requirement



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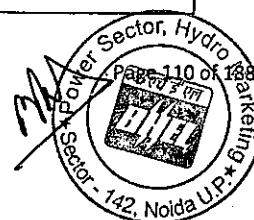
LT SWITCHGEAR

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(MCC, PCC, ACDB, DCDB, FUSE BOARDS, LOCAL PUSH BUTTON STATION, LOCAL MOTOR STARTERS)

ATTRIBUTES / CHARACTERISTICS →	ITEMS/ COMPONENTS/ SUB SYSTEM ASSEMBLY ↓	Make, Model, Type, Rating & TC	Dimensions & Finish	Electrical properties	Mechanical Properties	Chemical properties	Functional & Operational Features as per THDC Spec.	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint Shade, Adhesion, Thickness & Finish	Functional Checks	Milli-volt drop Test	IR - HV - IR Test	Degree of Protection Routine test as per THDC spec	All Routine tests as per THDC spec. & relevant std.
	Fuse (IS 13703)	Y	Y				Y	Y							
	Control Transformer (IS : 12021)	Y	Y				Y	Y			Y				Y
	Push Buttons (IS : 4794)	Y	Y				Y	Y			Y				
	Transducer (IEC : 60688)	Y	Y				Y	Y			Y				Y
	MCB (IS : 8828)	Y	Y				Y	Y			Y				
	Breaker Handling Trolley	Y	Y				Y			Y	Y				Y
	Synthetic Rubber Gasket (IS : 11149)	Y	Y		Y	Y		Y							
	LT SWITCHGEAR (IS : 8623)	Y	Y				Y	Y	Y	Y	Y	Y	Y	Y	Y
Notes: 1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents. 2. Makes of all major Bought Out Items will be subject to THDC approval.															

Section-29: MPHEP-EM Works-QAI Requirement



HT SWITCHGEAR

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ATTRIBUTES / CHARACTERISTICS →	Make, Type, Model, Rating & TC	Electrical Properties	Mechanical properties	Chemical Properties	Dimensions & Finish	Functional & Operational Features as per THDC Spec.	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint shade, thickness, adhesion & finish	Functional Checks	HV & IR Test	Degree of Protection Routine test as per THDC spec.	CB Operation timing check	All Routine Tests as per relevant standard
ITEMS, COMPONENTS, SUB-SYSTEM ASSEMBLY ↓														
Aluminum Bus bar material (IS : 5082)	Y	Y	Y	Y	Y		Y							
Copper Bus bar material (IS : 613)	Y	Y	Y	Y	Y		Y							
Bus bar Support Insulator	Y	Y	Y		Y		Y				Y			
HT Circuit Breaker (IEC-62271-100)	Y				Y	Y	Y			Y			Y	Y
HT Contactors (IS : 9046 / IEC 60470)	Y				Y	Y	Y			Y				Y
Protection & Auxilliary Relays (IS : 3231 / 8686)	Y				Y	Y	Y			Y				Y
HT CT's & PT's (IS : 2705 / 3156)	Y				Y		Y							Y
HT Fuses (IS : 9385)	Y				Y	Y	Y							
Surge Arrester (IEC : 99 -4)	Y				Y		Y							Y
LT Contactors (IS : 13947)	Y				Y	Y	Y			Y				
Control & Selector Switches (IS : 6875)	Y				Y	Y	Y			Y				
Indicating Meters (IS : 1248)	Y				Y	Y	Y			Y				Y
Indicating Lamps (IS : 13947)	Y				Y	Y	Y			Y				
Push Buttons (IS : 4794)	Y				Y	Y	Y			Y				
Control Transformer (IS : 12021)	Y				Y	Y	Y			Y				Y
LT Fuses (IS : 13703)	Y				Y	Y	Y							
Energy Meters (IS : 722)	Y				Y	Y	Y			Y				Y
Transducers (IEC : 60688)	Y				Y	Y	Y			Y				Y
Diodes	Y	Y			Y	Y	Y			Y				
Terminal Blocks	Y	Y			Y	Y	Y							
Synthetic Rubber Gasket (IS : 11149 / 3400)	Y	Y			Y		Y							
Breaker Handling Trolley	Y				Y	Y			Y	Y				
HT Switchgear Panel IEC-62271-200)	Y				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Make of all major Bought Out Items will be subject to THDC approval.

