

2X 800 MW NTPC GADERWARA STPP STAGE-I

VOLUME - II B

TECHNICAL SPECIFICATION

FOR

HYDROGEN GENERATION PLANT

SPECIFICATION NO.- PE-TS-394-168-A001



BHARAT HEAVY ELECTRICALS LIMITED

POWER GROUP

PROJECT ENGINEERING MANAGEMENT

NEW DELHI (INDIA)

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HYDROGEN GENERATION PLANT
2 X 800 MW NTPC GADERWARA STPP STAGE-I**

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**SECTION – A
SCOPE OF ENQUIRY**



TECHNICAL SPECIFICATION FOR HYDROGEN GENERATION PLANT 2 X 800 MW NTPC GADERWARA STPP STAGE-I

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1. SCOPE OF ENQUIRY

This specification is intended to cover design, engineering, manufacture, inspection, testing at manufacturer's works, supply/delivery duly packed (sea worthy packing for imported items) at site including freight, unloading, storage and handling at site, erection and Commissioning, trial run at site, PG test, obtaining CCE approval and plant handing over to Customer etc. inclusive of all prevailing taxes, duties and other levies of HYDROGEN GENERATION PLANT complete with all accessories including start up, mandatory spares and commissioning spares as required for the following project:

- **2X800 MW NTPC GADERWARA STPP STAGE-I**

1.2 Items though not specifically mentioned but needed to make the system complete as stipulated under these specifications are also to be furnished unless otherwise specifically excluded.

1.3 It is not the intent to specify all the details of the design & manufacture. However, the equipment shall be of proven design and conform in all respect to high standard of design, engineering & workmanship and shall be capable of performing the required duties in a manner acceptable to Engineer / Owner, who will interpret the meaning of drawing & the specification & shall be entitled to reject any work or material, which is not in full accordance herewith.

1.4 In case of any deviation, the Bidder shall indicate the same clause by clause in the deviation schedule. In the absence of the same it will be construed that the bid conforms strictly to the specification.

1.5 General terms & conditions, instructions to the tenderer & other attachments referred to elsewhere made part of this specification.


1.6 In case of any conflict between Section-C and Section-D, Section-C of the technical specification shall prevail over section D.

1.7 In case of any data/requirement stipulated in the drawings but not in the specification and vice-versa, such data /requirement shall be deemed to be contained in the both. Contradictions between drawings and specifications, if any, shall be brought to the attention of the purchaser/consultant by the bidder and the correct requirement shall be obtained.

1.8 In the event of any conflict between the various sections of the specification, bidder shall obtain necessary confirmation in writing from the purchaser.

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SECTION B PROJECT INFORMATION

CLAUSE NO.	PROJECT INFORMATION	ANNEXURE-I	
	<p style="text-align: center;">INTRODUCTION</p> <p>1.00.00 BACKGROUND</p> <p>Gadarwara Thermal Power Project (Gadarwara TPP) is being set up as a regional power project for the benefit of States/UTs of Western Region. This project is being set up in two stages. Each stage shall comprise of two units of 800 MW.</p> <p>1.01.00 Location and</p> <p>The site is located near villages Gangai & Umaraiya (about 9 Kms from Gadawara town in Narsingpur district of Madhya Pradesh. The major cities Bhopal & Jabalpur are located at about 210 Kms & about 140 kms respectively from proposed project site. The nearest BG Railway Station, Gadawara, on Jabalpur- Itarsi Section on central railway main Line is about 9 Kms from proposed project site.</p> <p>The nearest commercial airport, Bhopal and Jabalpur are located about 240 Kms and about 155 Kms respectively from site. The plant latitude and longitude are 22° 51' 42" N and 78° 52' 08" respectively.</p> <p>Vicinity plan of the proposed project is placed at Annexure –A-I</p> <p>1.02.00 Land</p> <p>About 1844 acres of land (Private Land- about 1480 acres and Govt. Land- about 364 acres) has been envisaged for the project. In-principle land availability clearance has been obtained from Govt. of Madhya Pradesh vide letter dated 19.05.08.</p> <p>1.03.00 Water</p> <p>The make-up water requirement is estimated as 4680 Cubic Meter/Hr with ash circulation system and about 5980 Cubic Meter/Hr with once through ash water system. The source of water for the Project is Narmada River at a distance of about 30 Kms from the project site.</p> <p>Govt. of Madhya Pradesh vide dated 19.05.08. has accorded water commitment from Narmada river for the project. CWC vide letter dated 27.07.12 have concurred water availability confirmation accorded by State Govt.</p> <p>1.04.00 Capacity</p> <p style="text-align: center;">2 x 800 MW - Present proposal</p> <p style="text-align: center;">2 x 800 MW - In Future</p>		
GADARWARA SUPER THERMAL POWER PROJECT (2X800 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL SPECIFICATION SECTION-VI PART-A	PROJECT INFORMATION <div style="border: 1px solid black; width: 100px; height: 40px; margin-top: 5px;"></div>



CLAUSE NO.	PROJECT INFORMATION	ANNEXURE-I	एनटीपीसी NTPC
1.05.00	Meteorological data Important meteorological data from nearest observatory at Narsinghpur is placed at Annexure-A-II .		
1.06.00	Plant Water Scheme The Plant water scheme is described below.		
1.06.01	Condenser Cooling (CW) Water System It is proposed to provide recirculating type CW system with induced draft type cooling towers. For the recirculating type CW system it is proposed to supply clarified water as make up. Raw water from the make-up water pump house shall be pumped to a Water Pretreatment Plant (PT - CW system). The treated clarified water shall be led to the cold water channel of CW system. Designed Clarified Water Analysis is given in this subsection. CW system shall be operated at a C.O.C of about 4.0. Chemical treatment programme (using acid dosing and scale cum corrosion inhibitors dosing) may be employed in addition to blow down of CW water to control the CW system chemistry in case CW system is required to be operated beyond 4.0 COC. CW blow down shall be drawn from the discharge of CW pumps and the same shall be led to a Service water Tank. For carrying circulating water from CW pump house to TG-area and from TG area to cooling tower, steel lined concrete encased duct would be provided. For interconnecting CW duct with CW pump, condenser and cooling towers, steel pipes would be used. Cooled water from cooling tower will be led to CW pump house through the cold water channel by gravity.		
1.06.02	Equipment Cooling Water (ECW) System (Unit Auxiliaries) The plant auxiliaries of Steam Generator and Turbine Generator shall be cooled by Demineralised (DM) water in a closed circuit. The primary circuit DM water shall be cooled through plate type heat exchangers by Circulating Water tapped from CW system in a closed secondary circuit. The hot secondary circuit cooling water shall be cooled in the cooling towers and shall be returned back to the system. It is proposed to provide independent primary cooling water circuit for Steam Generator & auxiliaries and TG & its auxiliaries.		
1.06.03	Station Auxiliaries Cooling Water System The station auxiliaries such as Air compressors, Compressors of ash handling plant, Cooling water circuit of Air Conditioning system, compressor of mill reject system etc. shall be cooled by separate cooling water System using separate set of pumps and cooling towers.		
GADARWARA SUPER THERMAL POWER PROJECT (2X800 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL SPECIFICATION SECTION-VI PART-A	PROJECT INFORMATION <div></div>

CLAUSE NO.	PROJECT INFORMATION	ANNEXURE-I	एनटीपीसी NTPC
1.06.04	<p>Ash Water System</p> <p>It is proposed to operate ash water system in a closed circuit. The ash water from the ash dyke shall be recirculated after treating a part of the quantity in a side stream lime softening plant as the case may be. Make up to the ash water system (to compensate for the ash water system blow down and evaporation loss in ash dyke) shall be supplied from excess CW blow down water (Service water) and raw water supply from water source of the plant. In addition, provision shall be kept to supply treated water from Central Monitoring Basin of Liquid Effluent Treatment Plant.</p>		
1.06.05	<p>Other Miscellaneous Water Systems</p> <p>a) CW system blow down water shall be used for the plant service water requirement, dust suppression system of coal handling plant, makeup to the Ventilation system, ash slurry pumps sealing, sealing of Vacuum pumps (if applicable) of Ash Handling plant, make-up to fire water storage tanks and cooling water requirement of hydrogen generation plant. The service (wash water) water collected from various areas shall be treated using oil water separators, tube settlers, coal settling pits etc. as per requirement and treated water from liquid effluent treatment plant shall be recycled back to the service water system for re-use. The excess service water shall be led to central monitoring basin for disposal.</p> <p>b) Separate water Pre-treatment plants are proposed for Circulating Water (PT-CW) system, Demineralisation Plant (PT-DM) plant and potable (PT-Pot) water systems.</p> <p>c) The drinking water requirement of the plant and colony shall be provided from the above mentioned Water (PT-Pot) pretreatment plant.</p> <p>d) Steam Cycle make-up water, makeup to the primary circuit of ECW (unit auxiliaries) system, boiler fill water and makeup to the hydrogen generation plant shall be provided from Demineralising plant.</p> <p>e) The quality of clarified water & DM water is given in this sub-section at Annexure-A-III.</p>		
1.07.00	<p>Criteria for Earthquake Resistant Design of Structures and Equipment</p> <p>All power plant structures and equipment, including plant auxiliary structures and equipment shall be designed as per the criteria specified in sub-section-D1 of Section-VI (Part-A).</p>		
<p>GADARWARA SUPER THERMAL POWER PROJECT (2X800 MW) STEAM TURBINE GENERATOR PACKAGE</p>		<p>TECHNICAL SPECIFICATION SECTION-VI PART-A</p>	<p>PROJECT INFORMATION</p>

CLAUSE NO.	PROJECT INFORMATION	ANNEXURE-I	एनटीपीसी NTPC
1.08.00	<p>In case the acceleration criteria considered by the Bidder for the design of anchorage bolts of Steam Turbine and Generator with TG Deck in his bid is different with respect to above criteria, he shall indicate the same in his bid. The same will be discussed with the Bidder and finalized considering the following:</p> <p>a) The earthquake design acceleration for the steam turbine and generator acting at the centre of gravity depends upon the layout/configuration/size of TG deck supporting columns and beams which are to be jointly decided by NTPC and the bidder.</p> <p>b) As the data regarding Foundation GA & loading data to be furnished by Bidder may not be available at tender stage, the acceleration criteria proposed by the bidder can not be confirmed for acceptance at the award stage. The same can be confirmed after jointly finalizing the TG substructure arrangement by NTPC and Bidder.</p> <p>c) TG deck acceleration values will be limited to the design values adopted by Bidder by suitably increasing the size of the TG supporting columns/beams during detailed engineering.</p> <p>Accordingly Bidder has to make equipment/piping layout clearing the TG column/beams.</p> <p>Criteria for Wind Resistant Design of Structures and Equipment</p> <p>All structures and equipment of the power plant, including plant auxiliary structures and equipment, shall be designed for wind forces as given as given in sub-section-D1 of Section-VI (Part-A).</p>		
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SECTION-C1

SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)



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GENERAL:

This specification is intended to cover design, engineering, manufacture, inspection, testing at manufacturer's works, supply/delivery duly packed (sea worthy packing for imported items) at site including freight, unloading, storage and handling at site, erection and Commissioning, trial run at site, PG test, obtaining CCE approval and plant handing over to Customer etc. inclusive of all prevailing taxes, duties and other levies of HYDROGEN GENERATION PLANT complete with all accessories including start up, mandatory spares and commissioning spares as required for the **2X800 MW NTPC GADERWARA STPP STAGE-I**.

Note:- Bidder to note that the technical specification is prepared considering unipolar and bipolar design both. So the equipment as applicable for Unipolar / Bipolar design as per manufacturer standard practice shall be supplied.

A) Major Mechanical scope:-

- Two streams of electrolyzers working in parallel (each of capacity minimum 10 Nm³/hr.).
- Three (3) numbers of hydrogen gas compressors and drives (each of minimum capacity 12.5 Nm³/hr) with cell purging system, mixing tank, DM tank, pumps to handle electrolyte and its filters, gas washing system, two gas holders each of minimum capacity 20 Nm³ wherever applicable.
- De-oxy units , coolers, hydrogen gas purification system, filling manifold, piping fitting, valves, 8 number empty hydrogen cylinders, 8 numbers empty nitrogen cylinders complete with required instrumentation and other items as per P&ID for the hydrogen generation plant enclosed with this technical specification.
- Bidder shall include vacuum pump and high-pressure cylinder testing apparatus along with all accessories for testing cylinders.
- Bidder to include the Ventilation Requirement for hazardous and non-hazardous area including toilets in his scope for the H₂ Plant building as per the requirement specified in the clause number 4.00.00, section D1 of technical specification. Bidder shall also include in his scope window Air-conditioners for his control Panels etc. Bidder to specify the same in his offer.
- Feed water / Cooling water:
FEED WATER: - Bidder shall be given DM water for hydrogen generation and cooling purpose (at the required rate at 1 kg/cm² (min) at one point near hydrogen generation plant building (10m). Further distribution shall be in bidder's scope.
COOLING WATER: - Bidder shall provide closed loop cooling with passivated DM water as make up. Bidder to include in his scope all the equipment and accessories required for closed loop cooling and passivation of DM water. Bidder shall indicate DM water make up requirements in the technical offer in case they adopt closed loop cooling with passivated DM water. Further distribution of cooling water to cells, compressor & other auxiliaries within the plant shall be in bidder's scope.
- Bidder shall include in his scope necessary support/platform /ladder/hanger /anchor bolts as required for satisfactory erection / commissioning & operation of plant shall be provided by bidder.
- Bidder shall include in his scope all hydrogen generation plant pipes and conduit support. All drains shall be terminated at point in hydrogen generation plant building.
- Bidder shall also provide connection, isolation device, manifold, piping etc. for N₂ gas connection to cell system for purging.
- Bidder to note that N₂ gas required for purging the system during commissioning/PG test/trial operation etc. till handing over the plant to CUSTOMER shall be arranged by bidder.



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- 11) Bidder shall also obtain the necessary clearances etc. from Govt. Agencies for the Hydrogen Generation plant. Hydrogen generation and storage system shall comply with all applicable federal state laws, and local ordinances.
- 12) Bidder shall guarantee that the equipment offered shall meet the rating and performance requirements for successful running of hydrogen Generation plant.

B) Electrical scope:

- 1) The scope of electrical works, equipment and services shall be as per table for electrical scope between BHEL and vendor enclosed in annexure – 4, section C2 of technical specification.
- 2) Constant speed Sq. cage type Electric motor shall be suitable for group IIC of IS 2148 which is equivalent to Class-I Div.II of NEC.
- 3) The other electrical design requirement shall be as specified in section D2 of technical specification.

C) Control and instrumentation scope:

- 1) All necessary instruments such as transmitters/temperature elements/sensors/switches/gauges etc. shall be provided for safe, efficient & reliable operation and maintenance of the H2 generation plant. All instrument devices shall be provided with explosion proof enclosure as described in NEC (USA) Article 500, Class – I, Div. I or to provide suitable type zener barriers of standard approved make meeting the requirements as approved by chief controller of explosives, India and other statutory authorities.
- 2) The control of hydrogen generation plant shall be dual processor based PLC system, PLC unit shall be provided with two processors (main processing unit and memories) one for normal operation and one as cold standby.
- 3) The PLC system shall be provided with necessary interface hardware and software for dual fiber optic connectivity and interconnection with station wide LAN (In employer's scope) for two-way transfer of signal for information sharing only of hydrogen generation plant. The plant information shall be made through Ethernet link following TCP / IP standard. The system shall be OPC compliant. The dual fiber optic communication cable between bidders control panels and employer's DDCMIS is included in bidder's scope.

The other control and instrumentation design requirement shall be as specified in section D3 of technical specification.

D) Civil scope:

- 1) All civil works including building & foundation of equipment are excluded from bidder's scope. However, bidders to note that complete grouting of the equipment, fixing etc. shall be in the scope of bidder.
- 2) Bidder shall furnish all applicable civil inputs details during detailed engineering.

E) COMMISSIONING SPARES

All the necessary commissioning spares shall be supplied as a part of base offer. Bidder will submit the list of commissioning spares for hydrogen generation plant along with the offer.

F) RECOMMENDED SPARES

Bidder to submit the list of recommended spares for 3 years of operation & maintenance along with the offer.

G) QUALITY ASSURANCE PLANS

Bidder to note the QP requirement shall be in line with the section C1 of technical specification. However, detailed QP, inspection checklist, certificate of conformance etc. for each sub-vendor shall be decided during



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detailed engineering. All inspection & testing etc. shall be carried out accordingly. Any changes/additional tests insisted upon by Owner during detailed engineering shall be accepted by bidder without any commercial implication to BHEL/Owner.

H) SUB VENDOR:

Bidder to note the sub vendors shall be selected from the sub vendor list enclosed in section C1 with the technical specification. Additionally proposed sub vendor over and above specified in the enclosed list shall be subjected to BHEL / Customer approval during detailed engineering without any commercial / delivery implication to BHEL / Customer. Requirement of detailed QP, inspection checklist, certificate of conformance etc. for each sub-vendor shall be finalized during detailed engineering stage; decision of BHEL/Owner shall be binding on vendor in this regard.

I) PG TEST:

Bidder shall perform the guarantee parameters enclosed in section C1 of technical specification requirement to the satisfaction of Owner. The exact modalities of verifying guarantee for the parameters indicated in the specification shall be finally as agreed with the Owner during detailed engineering & mutually agreed. The Bidder shall arrange all the monitoring gadgets / instruments / equipment required for performing guarantee parameters (returnable after PG test). Site facility as available or as extended by Owner shall only be provided.

J) TERMINAL POINTS

Feed water / cooling water:

TP1:- Feed water (Refer annexure – 1, section C1 for the feed water analysis):- Bidder to note that the DM quality feed water shall be terminated at one point (10 meter from hydrogen generation plant building) for hydrogen generation. Further distribution of DM feed water shall be in bidders scope.

TP2:- Bidder shall provide closed loop cooling with passivated DM water as makeup. Bidder to include in his scope all the equipments and accessories required for closed loop cooling and passivation of DM water. Bidder to also state their DM water make up requirements in case they adopt closed loop cooling with passivated DM water.

Further distribution of cooling water to cells, compressor & other auxiliaries within the plant shall be in bidder's scope.

Note:- Bidder to note that the temperature of feed water / cooling water at terminal point 1 and 2 shall be as per ambient conditions

TP3, Drains:- All drains shall be terminated at one point by bidder.

K) Painting:

Bidder to note that hydrogen generation plant painting for the imported items shall be equivalent or superior than the painting specification enclosed with the section C1 of technical specification. The painting of the indigenously supplied equipments shall be as per the section C1 of technical specification only. The color-coding for hydrogen generation plant shall be decided during detailed engineering.

L) DRAWINGS/DOCUMENTATION

Drawing/documents requirement (No. of hard copies/CD-ROM/floppies) shall be as stated drawing document distribution schedule, section C1 of technical specification. Bidder to note that all the drawings/documents including Process & instrumentation diagram, layout, piping, equipment data sheet, foundation drawing, control & instrumentation, general arrangement drawings, field quality plan, quality plan, erection drawings,



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O&M Manual, PG Test procedure, electrical single line diagram, plant control philosophy etc. as per document list enclosed in the specification shall be submitted for approval of BHEL/Owner during detailed engineering. In case any change is suggested by Owner to meet the system/specification requirement, the same shall be incorporated / carried-out without any commercial/delivery implication to the satisfaction of Owner/BHEL.

M) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the works for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The bidder without any extra charge shall provide the same.

N) POWER LOADING CRITERIA:

Sl.No.	Description	Gaderwara
1	Rate of loading during evaluation (per KW) (Refer note 1&2)	US \$ 4172
2	Rate of penalty during PG test (per KW) (Refer note 1 & 2)	US \$ 2845

Note 1: Bidder to note that for penalty 1/3 (33%) of power consumption quoted by bidder power consumption for one stream of the respective hydrogen generation plant) shall be used.

Note 2: Bidder shall submit format for guarantee power consumption in the format attached in, section-C1, duly filled in all respects along with the priced bid. The net differential loading amount (worked out in the following manner) will be added with respective bidder's total quoted price to derive the total price for evaluation. The consumption in KW quoted by the bidder in the format shall be loaded by the above indicated figure in s.no.1 for each KW increase in total consumption from base figure of 40KW. In case the successful bidder fails to establish/ prove the guaranteed values of power consumption on actual performance testing at the manufacturing works/ site, penalty by above indicated figure in s.no.2 per KW increases in power consumption shall be levied.

O) Mandatory Spares:

Mandatory spares shall be as per Mandatory spare list of section C1 of the technical specification.

P) Furnitures:

Bidder shall include in his scope at least one number chair, one no. keypad and one no. of locker set as furniture for the Hydrogen Generation Plant.



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ANNEXURE 1

DM WATER ANALYSIS

	<p>Sl.No. Characteristics</p> <p>1. Silica (Max.)</p> <p>2. Iron as Fe</p> <p>3. Total hardness</p> <p>4. pH value</p> <p>5. Conductivity</p>	<p>Value</p> <p>0.02 ppm as Sio2</p> <p>Nil</p> <p>Nil</p> <p>6.8 -7.2</p> <p>Not more than 0.1micro mho/cm excluding the effects of free CO2</p>



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**ANNEXURE-2
SERVICE WATER ANALYSIS**

Sl. No.	Constituent	as	mg per litre
1.	Calcium	CaCO ₃	112
2.	Magnesium	CaCO ₃	66
3.	Sodium + Potassium	CaCO ₃	49
	Total Cations	CaCO ₃	28
4.	Total Alkalinity	CaCO ₃	137
5.	Chloride	CaCO ₃	48
6.	Sulphate	CaCO ₃	44
	Total Anions	CaCO ₃	228
7.	Silica (Reactive)	Si	10
8.	Iron (total)	Fe	0.3 mg/l
9.	pH Value	-	7.7 - 8.0
10.	Organics (KMnO ₄)		2
11.	Turbidity	NTU	Upto 500



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**ANNEXURE 3
GUARANTEED PERFORMANCE DATA**



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SL.NO	DESCRIPTION	PARAMETER
	BHEL Job Number	394
1	Hydrogen generation plant Minimum capacity (Nm ³ /hr.)	20
2	Number of streams (2X50%)	2
3	Minimum Capacity of each Streams/electrolyser (Nm ³ /hr.)	10
4	Hydrogen purity (%) at gas manifolds	99.9
5	Moisture content - gm/m ³ (max)	0.05
6	Design delivery pressure at its rated duty point Kg/cm ² (g)	150
7	Minimum capacity of each Compressor (Nm ³ /hr.)	125% of rated Capacity of each Streams/electrolyser (Nm ³ /hr.)
8	Vibration level of compressor	As per internationally accepted standard
9	Noise level of compressor	85 dBA (to a reference of 0.0002 micro bar).



**TECHNICAL SPECIFICATION FOR
HYDROGEN GENERATION PLANT
2 X 800 MW NTPC GADERWARA STPP STAGE-I**

SPEC NO. PE-TS-394-168-A001

VOLUME-IIB

SECTION

REV.NO.0

DATE

SHEET

QUALITY APPROVAL PLANS

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
<p>9.00.00</p> <p>9.01.00</p>	<p>QUALITY ASSURANCE PROGRAMME</p> <p>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 ISO-9001.A quality assurance programme of the contractor shall generally cover the following:</p> <ul style="list-style-type: none"> (a.) His organisation structure for the management and implementation of the proposed quality assurance programme (b.) Quality System Manual (c.) Design Control System (d.) Documentation and Data Control System (e.) Qualification data for bidder's key personnel. (f.) 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. (g.) System for shop manufacturing and site erection controls including process, fabrication and assembly. (h.) Control of non-conforming items and system for corrective actions and resolution of deviations. (i.) Inspection and test procedure both for manufacture and field activities.

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
	<p>(j.) Control of calibration and testing of measuring testing equipment.</p> <p>(k.) System for Quality Audits.</p> <p>(l.) System for identification and appraisal of inspection status.</p> <p>(m.) System for authorising release of manufactured product to the Employer.</p> <p>(n.) System for handling, storage and delivery.</p> <p>(o.) System for maintenance of records, and</p> <p>(p.) 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.</p>
9.02.00	GENERAL REQUIREMENTS - QUALITY ASSURANCE
9.02.01	<p>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 which shall be finalised giving due consideration to the manufacturer's standard and proven practices being followed. 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. Monthly progress reports on MQP/FQP submission/approval shall be furnished on enclosed format No. QS-01-QAI-P-02/F1.</p>
9.02.02	<p>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 through c-folders, a web based system of NTPC ERP in addition to hard copy, for</p>

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
	review and approval. After approval the same shall be submitted in compiled form on CD-ROM.
9.02.03	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.
9.02.04	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 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 and dispositioning.
9.02.05	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).
9.02.06	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.
9.02.07	The contractor shall submit to the Employer Field Welding Schedule for field welding activities in the enclosed format No.: QS-01-QAI-P-02/F2. 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 ninety days before schedule start of erection work at site.
9.02.08	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.

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
	All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.
9.02.09	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.
9.02.10	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.
9.02.11	For all IBR pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. However, for other piping systems ASME B31.1 or other relevant code as applicable shall be followed. Similarly, 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.
9.02.12	Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.
9.02.13	No welding shall be carried out on cast iron components for repair.
9.02.14	All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
9.02.15	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) / EN / Equivalent. 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.
9.02.16	<p>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.</p> <p>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</p>

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
<p>9.02.17</p> <p>9.02.18</p> <p>9.02.19</p>	<p>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 reports on sub-contractor detail submission / approval shall be furnished on enclosed on format no. QS-01-QAI-P-02/F1. Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.</p> <p>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.</p> <p>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.</p> <p>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</p>

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
9.02.20	<p>the specification, in addition to carrying out tests as per the approved quality plan.</p> <p>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.</p>
9.02.21	<p>For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.</p>
9.02.22	<p>Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.</p>
9.02.23	<p>Environmental Stress Screening</p> <p>All solid state electronic system / equipment / sub assembly shall be free from infant mortile components. For establishing the compliance to this requirement, the contractor / sub - contractor should meet the following.</p> <p>1) The Contractor / Sub - contractor shall furnish the established procedure being followed for eliminating infant mortile components. The procedure followed by the Contractor / Sub - contractor should be substantiated along with the statistical figures to validate the procedure being followed. The necessary details as required under this clause shall be furnished at the stage of QP finalization.</p> <p style="text-align: center;">Or</p> <p>In case the Contractor / Sub - contractor do not have any established procedure to eliminate infant mortile components then two or 10% which ever is less, most densely populated Panels shall be tested for Elevated Temperature Cycle Test as per the following procedure.</p> <p>Elevated Temperature Test Cycle</p> <p>During the elevated temperature test which shall be for 48 hours, the ambient temperature shall be maintained at 50° C. The equipment shall be interconnected with devices and kept under energized conditions so as to repeatedly perform all operations it is expected to perform in</p>

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	<div><p>actual service with load on various components being equal to those which will be experienced in actual service.</p><p>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° C above the ambient temperature at 50° C.</p><p>In case of any failure during the test cycle, the further course of action should be mutually discussed for demonstrating the intent of the above requirement.</p></div>		
2)	<div><p>Burn in Test Cycle</p><p>The test shall be conducted on all the panels fully assembled and wired including the panels having undergone the above mentioned elevated temperature test.</p><p>The period of Burn in Test Cycle shall be 120 hrs and process shall be similar to the elevated temperature test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time.</p><p>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 systems; the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable.</p><p>During the Burn in 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° C above the ambient temperature.</p><p>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.</p></div>		

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
9.03.00	QA DOCUMENTATION PACKAGE
	<p>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.</p>
9.03.01	<p>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.</p> <p>The QA Documentation file shall be progressively completed by the Supplier's sub- supplier to allow regular reviews by all parties during the manufacturing.</p> <p>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.</p>
9.03.02	<p>Typical contents of QA Documentation is as below:-</p> <ul style="list-style-type: none"> (a.) Quality Plan (b.) Material mill test reports on components as specified by the specification and approved Quality Plans. (c.) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans. (d.) 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. (e.) Heat Treatment Certificate/Record (Time- temperature Chart) (f.) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure). (g.) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points. (h.) Certificate of Conformance (COC) wherever applicable. (i.) MDCC

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
9.03.03	NOT USED.
9.03.04	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.
9.03.05	<p>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.</p> <p>(a.) 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.</p> <p>(b.) 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.</p> <p>(c.) If a decision is made for 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.</p>
9.03.06	<p>TRANSMISSION OF QA DOCUMENTATION</p> <p>On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Employer.</p> <p>For the particular case of phased/part derivatives of equipment, the complete quality document of that particular equipment to the Employer shall be issued not later than 3 weeks after the date of the last delivery of equipment.</p>

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9.04.00	Project Manager's Supervision
9.04.01	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 Project Manager and without prejudice to the provisions of 'Arbitration' clause in Section GCC of Vol.I, the Contractor shall proceed to comply with the Project Manager's decision.
9.04.02	<p>The work shall be performed under the supervision of the Project Manager. The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following:</p> <ul style="list-style-type: none"> (a.) Interpretation of all the terms and conditions of these documents and specifications: (b.) Review and interpretation of all the Contractor's drawing, engineering data, etc: (c.) 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 : (d.) Inspect, accept or reject any equipment, material and work under the contract: (e.) Issue certificate of acceptance and/or progressive payment and final payment certificates (f.) Review and suggest modifications and improvement in completion schedules from time to time, and (g.) Supervise Quality Assurance Programme implementation at all stages of the works.
9.05.00	INSPECTION, TESTING AND INSPECTION CERTIFICATES
9.05.01	The word 'Inspector' shall mean the Project Manager 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.
9.05.02	The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
	<p>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 Project Manager 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.</p>
9.05.03	<p>The Contractor shall give the Project Manager/Inspector ten (10) working days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within ten (10) working days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.</p>
9.05.04	<p>The Project Manager or Inspector shall within ten (10) working days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.</p>
9.05.05	<p>When the factory tests have been completed at the Contractor's or sub-contractor's works, the Project Manager /Inspector shall issue a certificate to this effect ten (10) working days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within ten (10) working days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /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.</p>
9.05.06	<p>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 Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the</p>

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
	Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.
9.05.07	The inspection by Project Manager / 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.
9.05.08	To facilitate advance planning of inspection in addition to giving inspection notice as specified at clause no 9.05.03- of this chapter, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.
9.05.09	All inspection, measuring and test equipment 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 NTPC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.
9.06.00	ASSOCIATED DOCUMENT FOR QUALITY ASSURANCE PROGRAMME:
9.06.01	List of items requiring Quality Plan & Sub-supplier approval. Format No. QS-01-QAI-P-01/F3-R0
9.06.02	Status of Quality Plan and Sub-supplier approval Format No. QS-01-QAI-P-02/F1-R0
9.06.03	Field Welding Schedule Format No.: QS-01-QAI-P-02/F2-R0
9.06.04	Manufacturing Quality Plan Format No.: QS-01-QAI-P-09/F1-R0
9.06.05	Field Quality Plan Format No.: QS-01-QAI-P-09/F2-R0
	The above formats are enclosed as Annexure-III to VII


CLAUSE NO.	QUALITY ASSURANCE													<div>एनटीपीसी NTPC</div>
	HYDROGEN GENERATION PLANT													
	HYDROGEN GENERATION PLANT-TESTS													
	TESTS/CHECK ITEM / COMPONENTS	Material Test	WPS/PQR/Welder Qualification	DPT/MPI	Ultrasonic test	RT	Pneumatic test	Hydraulic/Water Fill tests	Assembly/fit up	Dimension	Functional/operational tests	Performance tests	Other tests	Remarks
	H2 PLANT													
	A. COMPRESSOR								Y		Y	Y		
	1) Casing	Y ³												
	2) Crank shaft/ connecting rod	Y ³		Y	Y					Y				
	3) Piston/Diaphragm			Y ³							Y			
	B. DRYING PLANT							Y						
	1) Raw material identification	Y ³		Y ¹		Y ²								
C. HYDROGEN GENERATOR							Y			Y	Y			
D. CELL MODULE							Y			Y	Y			
E. GAS HOLDER	Y ³						Y							
<div>1. Fillet welds/nozzles welds and knuckle portion of dished ends and all butt welds.</div> <div>2. 100% butt welds and 100% for Tee joints and dished ends welds.</div> <div>3. One per heat /HT batch.</div> <div>Notes.</div> <div>1. Quantum of checks shall be 100% unless otherwise specified.</div>														




INDUCTION MOTOR & SYNCHRONOUS MACHINE

TESTS/CHECKS TEMS/COMPONENTS	Visual	Dimensional	Make/Type/Rating/TC/General Physical Inspection	Mech/Chem. Properties	NDT /DP/MP/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment	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 & polarisation index test
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			Y		Y						
Rotor Copper/Aluminium	Y	Y	Y	Y		Y	Y		Y									
Stator copper	Y	Y	Y	Y			Y		Y			Y						
SC Ring	Y	Y	Y	Y	Y	Y	Y	Y	Y									
Insulating Material	Y	Y	Y	Y			Y					Y						
Tubes for Cooler	Y	Y	Y	Y	Y				Y		Y							
Sleeve Bearing	Y	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						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												Y	Y	Y	Y1
Note: 1. This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed along with relevant supporting documents during QP finalization. However, No QP for LT motor up to 50KW. 2. Makes of all major bought out items will be subject to NTPC approval. Y1 = for HT Motor / Machines only.																		


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CLAUSE NO.		QUALITY ASSURANCE															
L.T. POWER CABLES (1.1 KV PVC & XLPE CABLES)																	
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 NTPC Spec.	Routine and acceptance test as per Relevant Standard and NTPC 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) ASTM-D-2843/ ASTM-D-2863 IEC-754 Part-I	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 & 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: This is an indicative list of test/checks. The manufacturer is to furnish a detailed quality plan indicating the practice and procedure along with relevant supporting documents.																	
* 2. Not applicable for XLPE insulation																	

CLAUSE NO.	QUALITY ASSURANCE		
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		
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		

CLAUSE NO.		QUALITY ASSURANCE														<div>एनटीपीसी</div> <div>NTPC</div>	
L.T. CONTROL CABLES (1.1 KV PVC CABLES)																	
<div>Attributes / Characteristics</div> <div>Item / Components / Sub Assembly</div>	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 NTPC	Routine & Acceptance test as per relevant standard & page 2 & 3 of this table	FRLS Test		
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					
1.Note : This is an indicative list of test/checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and procedure along with relevant supporting documents.																	


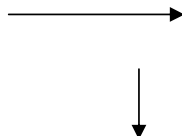
CLAUSE NO.	QUALITY ASSURANCE			<div>एन टी पी सी NTPC</div>
CONTROL CABLE				
ROUTINE TESTS				
Routine tests shall be carried out on each drum of finished cables for all types & sizes.				
Following shall constitute routine tests:				
1)	Conductor Resistance test			
2)	High voltage test at room temperature			
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			

CLAUSE NO.	QUALITY ASSURANCE			
C) 1) 2) D) 1) 2) E) 1) 2) 3) 4) 5) 6) 7) F) 1)	For PVC insulation & PVC Sheath Test for thickness Tensile strength & Elongation before ageing For completed cables Insulation resistance test (Volume resistivity method) High voltage test at room temperature Following tests shall be carried out and only one sample shall be taken from each offered lot of all sizes for these tests:- Tensile strength & elongation after ageing on PVC insulation and PVC outer sheath Thermal stability test on PVC insulation and outer sheath Oxygen index test on outer sheath Smoke density rating test on outer sheath as per ASTM –D 2843 Acid gas generation test on outer sheath as per IEC – 754 (Part 1) Flammability test as per IEC-332 - Part- 3 (Category- B) on completed cable Fire resistance test as per SS 4241475 (F3 Category) on completed cable Following tests shall be carried on one length of each size of offered lot: Surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires			

CLAUSE NO.		QUALITY ASSURANCE														<div>एनटीपीसी NTPC</div>	
INSTRUMENTATION CABLE																	
ITEMS	TESTS																
		Conductor Resistance ® & (A)	High Voltage ® & (A)	Insulation Resistance ® & (A)	Constructional detail, dimensions (A)	Outer-Sheathe/core marking, end sealing (A)	Thermal Stability (A) +	Visual, Surface finish (A) +	Electrical Parameters ** (A) +	Persulphate Test (A) +	Overall/Coverage/Continuity (A)	Swidesh chimney Test (SS-4241475) (A) ++	FRLS Test * (A) ++	Tensile & Elongation before & after aging (A) ++	Vol. Resistivity. at room & Elevated Temp. (A) ++	Spark test report review ®	
1. Instrument cable twisted and shielded																	
Conductor(IS-8130)		Y				Y			Y								
Insulation(VDE-207)						Y	Y	Y	Y					Y		Y	
Pairing/Twisting						Y	Y		Y								
Shielding						Y			Y			Y					
Drain wire		Y				Y			Y		Y	Y					
Inner Sheath						Y	Y	Y	Y					Y	Y		
Outer Sheath						Y	Y	Y	Y					Y	Y		
Over all cable		Y	Y	Y		Y	Y		Y	Y		Y				Y	
Cable Drums(IS-10418)						Y			Y								
<p>Note : High Temp. cables shall be subjected to tests as per VDE-207(Part-6) Compensating cables shall be checked for Thermal EMF/Endurance test as per IS 8784.</p> <p>Note : This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating his practice & Procedure along with relevant supporting documents during QP finalization for all items.</p> <p>Note : ® - Routine Test A - Acceptance Test Y - Test Applicable</p> <p>Note : Sampling Plan for Acceptance test shall be as per IS 8784 (As applicable)</p> <ul style="list-style-type: none">* FRLS Tests: Oxygen / Temp Index (ASTM D-2863), Smoke Density Rating (ASTM – D 2843), HCL Emission (IEC-754-1)** Characterisitic Impedence, Attenuation, Mutual Capacitance, Cross Talk (As applicable) <p>+ Sample size will be One No. of each size/type per lot.</p> <p>++ Sample size will be One No. sample for complete lot offered irrespective of size/type.</p>																	

CLAUSE NO.		QUALITY ASSURANCE										<div>एनटीपीसी</div> <div>NTPC</div>	
LIGHTING													
<div>Item Components Sub System Assembly</div> <div>Attributes Characteristics</div>	Make, Type , Rating/ TC	Dimension	Pre-Treatment of sheets	Paint Shade Thickness Adhesion & Finish	Test for Galvanization	IP Test	Bought Out Items/ Bill of Material	HV & IR	Functional Check as per spec.	Constructional Feature as per NTPC spec.	Routine Test as per relevant std and spec	Acceptance Test as per relevant std and spec	Item to conform to relevant standard
Luminaries (IS-10322 Part-5 Sec.1; IS- 2206)	Y					Y		Y			Y	Y	
Electronic Ballast	Y										Y	Y	Y
Lighting Wire (IS-694)	Y										Y		
Pole (IS-2713)	Y			Y						Y	Y	Y	
Lamps (IS-9800, IS-9974)	Y										Y	Y	
Switch Box/ Junction Box/Receptacles/ Local Push Button, Lighting Panel / flame proof type (IS-513, 2629, 2633, 4759, 6745, 2148)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Cable Gland (BS-6121)	Y	Y									Y		
Cable Lug (IS-8309)	Y	Y									Y		
Flexible Conduit	Y										Y		
Lighting Transformer (IS-1117, 11333)	Y									Y	Y		
Epoxy & Galvanised Conduit (IS-9537, 2629, 2633, 4759, 6745)	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 NTPC approval.													

CLAUSE NO.		QUALITY ASSURANCE												<div>एनटीपीसी</div> <div>NTPC</div>		
CABLING, EARTHING, LIGHTNING PROTECTION																
ATTRIBUTES / CHARACTERISTICS		ITEMS/COMPONENTS / SUB SYSTEMS	Dimension	Paint shade, paint thickness, adhesion	Pre-treatment of sheet	IP protection	Proof load*	Surface finish	Deflection test*	HV & IR	Galvanise Test (If Applicable)	Functional	Bought out items/Bill of material	Routine tests as per relevant standard & specification	Acceptance tests as per relevant standard & specification	Constructional feature as per NTPC
		Cable glands(BS-6121)	Y											Y		
		Cable lug(IS-8309)	Y											Y		
		Lighting wire(IS-694)	Y											Y		
		Flexible conduits	Y											Y		Y
		Conduits(Galvanized & Epoxy) IS-9537 & IS-2629,2633 ,6745	Y		Y								Y	Y		Y
		RCC Hume Pipe (IS-458)												Y		
		Cable straight through joint (VDE-0278)	Y											Y		Y
		Cable Trays, & supports system & accessories IS-513, 2629,2633,6745	Y		Y		Y	Y	Y	Y	Y	Y		Y	Y	Y
		Trefoil clamp	Y													Y
		GI flats for earthing & lighting protection (IS 2062, 2629, 6745,2633)	Y		Y						Y			Y		Y
		GI wire (IS-280)	Y											Y		
		Fire Sealing System (BS – 476)												Y	Y	Y
<div>.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.</div> <div>2. Make of all items will be subject to NTPC approval.</div>																

CLAUSE NO.		QUALITY ASSURANCE													
LT SWITCHGEAR (MCC, PCC, ACDB, DCDB, FUSE BOARDS, LOCAL PUSH BUTTON STATION, LOCAL MOTOR STARTERS)															
<div>ATTRIBUTES / CHARACTERISTICS</div> <div></div> <div>ITEMS/ COMPONENTS/ SUB SYSTEM ASSEMBLY</div>	Make, Model, Type, Rating & TC	Dimensions & Finish	Electrical properties	Mechanical Properties	Chemical properties	Functional & Operational Features as per NTPC 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 NTPC spec	All Routine tests as per NTPC spec. & IS	
	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 (IS : 3231)	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								

CLAUSE NO.		QUALITY ASSURANCE												<div>एनटीपीसी</div> <div>NTPC</div>	
LT SWITCHGEAR															
(MCC, PCC, ACDB, DCDB, FUSE BOARDS, LOCAL PUSH BUTTON STATION, LOCAL MOTOR STARTERS)															
<div>ATTRIBUTES / CHARACTERISTICS</div> <div>ITEMS/COMPONENTS/SUB SYSTEM ASSEMBLY</div>		Make, Model, Type, Rating & TC	Dimensions & Finish	Electrical properties	Mechanical Properties	Chemical properties	Functional & Operational Features as per NTPC 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 NTPC spec.	All Routine tests as per NTPC spec. & IS
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 NTPC approval.															

CLAUSE NO.	QUALITY ASSURANCE															<div>एन टी पी सी</div> <div>NTPC</div>	
LT BUSDUCT																	
ATTRIBUTES CHARACTERISTICS → ↓ ITEM, COMPONENTS, SUB SYSTEM ASSEMBLY	Dimension & Surface Finish	Make, Type, Rating & TC	Electrical Properties	Mechanical Properties	Chemical Properties	Item to conform to relevant IS	WPS Approval, Welder Qualification	Weld Quality Check (DP test & x-ray Test)	Paint Shade, Thickness, Adhesion & Finish	Tightness by Torque measurement	Electrical Clearances	Galvanizing Test as per IS 2629/ 2633/ 4759	IR – HV – IR Test	Phase Sequence Check	Degree of Protection routine test as per NTPC spec.		
Aluminum Sheets / Plates / Strips / Flexibles / tubes (IS : 5082 / 737)	Y	Y		Y	Y	Y	Y	Y									
CRCA Flats / ISMC (IS 2062)	Y	Y		Y	Y	Y											
Neoprene / Synthetic Rubber Gaskets (IS 11149 / 3400)	Y	Y		Y	Y												
Rubber Bellows (IS : 3400)	Y	Y		Y	Y												
Support Insulator	Y	Y	Y	Y													
Galvanized Structure & GI Earthing Flat (IS : 2629 / 2633 / 4749)	Y	Y				Y						Y					
Space Heater & Thermostat		Y	Y										Y				
LT Busduct (IS : 8623 PART 2)	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 NTPC approval.																	

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CLAUSE NO.	QUALITY ASSURANCE														<div>एनटीपीसी NTPC</div>
	<div>ATTRIBUTES/ CHARACTERISTICS</div> <div>ITEMS/COMPONENTS/ SUB-ASSEMBLY</div>	Make, Model, Type, Rating & Finish	Chemical & Mechanical Tests	Sheet Steel Pretreatment & Painting process checks	Conform to relevant Standard	Dimensional check and Paint shade, thickness, adhesion & Finish checks	Complete physical examination for constructional features of Battery Charger as per NTPC specification	Temperature Rise Test	Dynamic Response Test	Ripple Content Test, Load Limiter & Annunciator & AVR Operation Test	Operational & Functional Checks	HV & IR Test	Burn-In Test at 50°C for 48 hrs	Degree of Protection Test as per NTPC Spec.	
		BATTERY CHARGER Rectifier Transformer (IS:2026) Electronic Components including Potentiometer (Vernier Type) PCB & Electronic Cards 19" standard racks for electronic cards Control & Selector Switches (IS : 6875) Indicating Meters (IS : 1248) Indicating Lamps (IS: 13947) Air Break Switches / Fuses (IS : 13947 / 13703) Control Terminal Blocks (IS :13947) Control Transformer (IS : 12021) Push Buttons (IS:4794) MCB (IS : 8828) PVC insulated Copper control wires (IS : 694) Sheet Steel (IS : 513) Synthetic Rubber Gaskets Annunciator Battery Charger	Y Y												

CLAUSE NO.	QUALITY ASSURANCE																	<div>एनटीपीसी NTPC</div>
	POWER SUPPLY SYSTEM																	
	<div>TEST</div> <div>ITEMS</div>	Visual/dimension/rating/ Paint Adhesion/ Thickness (R)	General arrangement/BOM/make of components /Mimic ®	Efficiency, regulation(R)	Input voltage variation (A)	Out put voltage and frequency adj.range(A)	Premilinary light load test(R)	Load transfer retransfer test (R) *	AC input failiure and return test (R)	Parralel operation and current divison(R)	Relative harmonic content(R)	Restart with PRI A.C and battery (separately)(R)	System transfer and retransfer (R)*	Asynchronous transfer(R)	Ripple content(R)	Load limiter operation (R)	IR/HV(R)	Tests as per standard &specification (R)&(A)
	UPS/CONVERTER (IEC-146 PT-4)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	VOLTAGE STABILISER	Y	Y	Y	Y	Y					Y		Y				Y	
	LEAD ACID BATTERY (TUBLAR)-IS-1651																	Y
	LEAD ACID BATTERY (PLANTE)-IS-1652																	Y
	NICKEL CADMIUM BATTERY (IS-10918/IEC-623)																	Y
	R-Routine Test		A- Acceptance Test							Y - Test applicable								
	<p>* Transfer time and Over shoot /under shoot during load & system transfer shall be recorded.</p> <p>Note: 1) Detailed procedure of Environmental Stress Screening test shall be as per Quality Assurance Programme in General Technical Conditions</p> <p>2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.</p>																	

CLAUSE NO.	QUALITY ASSURANCE													<div>एनटीपीसी NTPC</div>
	ELECTRIC POWER SUPPLY SYSTEM													
	<div>ATTRIBUTRES/ CHARACTERISTICS</div> <div>ITEMS/COMPONENTS SUB-ASSEMBLY</div>	Make, Model, Type, Rating & Finish	Chemical & Mechanical Tests	Sheet Steel Pretreatment & Painting process checks	Conform to relevant Standard	Dimensional check and Paint shade, thickness, adhesion & Finish checks	Complete physical examination for constructional features of Battery Charger as per NTPC specification	Temperature Rise Test	Dynamic Response Test	Ripple Content Test, Load Limiter & Annunciator & AVR Operation Test	Operational & Functional Checks	HV & IR Test	Burn-In Test at 50°C for 48 hrs	Degree of Protection Test as per NTPC Spec.
	BATTERY CHARGER Rectifier Transformer (IS:2026) Electronic Components including Potentiometer (Vernier Type) PCB & Electronic Cards 19" standard racks for electronic cards Control & Selector Switches (IS : 6875) Indicating Meters (IS : 1248) Indicating Lamps (IS: 13947) Air Break Switches / Fuses (IS : 13947 / 13703) Control Terminal Blocks (IS :13947) Control Transformer (IS : 12021) Push Buttons (IS : 4794) MCB (IS : 8828) PVC insulated Copper control wires (IS : 694) Sheet Steel (IS : 513) Synthetic Rubber Gaskets Annunciator Battery Charger	Y Y												

CLAUSE NO.	QUALITY ASSURANCE																<div>एनटीपीसी NTPC</div>			
	POWER SUPPLY SYSTEM																			
	ITEMS	TESTS	Visual/dimension/rating/ Paint Adhesion/ Thickness (R)	General arrangement/BOM/make of components /Mimic ®	Efficiency, regulation(R)	Input voltage variation (A)	Out put voltage and frequency adj.range (A)	Premilitary light load test (R)	Load transfer retransfer test (R) *	AC input failure and return test (R)	Parallel operation and current division (R)	Relative harmonic content (R)	Restart with PRI A.C and battery (separately) (R)	System transfer and retransfer (R)*	Asynchronous transfer (R)	Ripple content (R)	Load limiter operation (R)	IR/HV(R)	Tests as per standard &specification (R)&(A)	
			UPS/CONVERTER (IEC-146 PT-4)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
			VOLTAGE STABILISER	Y	Y	Y	Y	Y					Y		Y				Y	
			LEAD ACID BATTERY (TUBLAR)-IS-1651																	Y
			LEAD ACID BATTERY (PLANTE)-IS-1652																	Y
	NICKEL CADMIUM BATTERY (IS-10918/IEC-623)																		Y	
	R-Routine Test			A- Acceptance Test						Y - Test applicable										
	* Transfer time and Over shoot /under shoot during load & system transfer shall be recorded.																			
	Note: 1) Detailed procedure of Environmental Stress Screening test shall be as per Quality Assurance Programme in General Technical Conditions																			
2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.																				

CLAUSE NO.	QUALITY ASSURANCE										<div>एनटीपीसी NTPC</div>
	MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)										
	<div>TESTS</div> <div>ITEMS</div>	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Test as per standard (R)	Insulation Resistance (R)	IBR Certification (if applicable) (R)	Hydro Test (R)	Material Test certificate ®	
	1. PR Gauge (IS-3624)	Y	Y	Y	Y	Y					
	2. Temp. Gauge (BS-5235)	Y	Y	Y	Y	Y					
	3. Pr./D.P.Switch(BS-6134)	Y	Y	Y	Y	Y	Y				
	4. Electronic Transmitter(IEC-770)	Y	Y	Y	Y	Y	Y				
	5. Temp. Switch	Y	Y	Y	Y	Y	Y				
	6. Recorder(IS-9319/ANSI C-39.4)	Y	Y	Y	Y	Y	Y				
	7. Vertical indicators	Y	Y	Y	Y		Y				
	8. Digital Indicators	Y	Y	Y	Y		Y				
	9. Integrators	Y	Y	Y	Y						
	10. Electrical Metering Instrument (IS-1248)	Y	Y	Y	Y	Y	Y				
	11. Transducer (IEC-688)	Y	Y	Y	Y	Y	Y				
	12. Thermocouples (ANSI-MC-96.1)	Y	Y	Y	Y	Y	Y				
	13. RTD (IEC-751)	Y	Y	Y	Y	Y	Y				
	14. Thermowell	Y		Y				Y	Y	Y	
	R-Routine Test A- Acceptance Test Y - Test applicable										
	Note: 1) Detailed procedure of Environmental Stress screening test shall be as per Quality Assurance Programme in General Technical Conditions 2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.										

CLAUSE NO.	QUALITY ASSURANCE													<div>एनटीपीसी NTPC</div>
	<div>TESTS</div> <div>ITEMS</div>		Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Requirement as per standard (R)	WPS approval (A)	Non-destructive testing (R)	Calculation for accuracy (R)	Insulation Resistance (R)	IBR Certification as applicable (R)	Hydro test (R)	Material test certificate (A)
	15. Cold junction compensation box		Y	Y	Y	Y					Y			
	16. Orifice plate (BS-1042)		Y	Y	Y	Y*	Y	Y**	Y**			Y	Y**	Y
	17. Flow nozzle (BS-1042)		Y	Y	Y	Y*	Y	Y	Y			Y	Y	Y
	18. Impact head type element		Y	Y	Y					Y				Y
	19. Level transmitter/float type switch		Y	Y	Y	Y					Y	Y	Y	Y
	20. Flue Gas analyser		Y	Y	Y	Y								
	21. Dust emission monitors		Y	Y	Y	Y								
	* Calibration to be carried out on one flow element of each type and size if calibration carried out as type test same shall not be repeated.													
** If applicable														
		R-Routine Test A- Acceptance Test Y - Test applicable												
		Note: 1) Detailed procedure of Environmental Stress screening test shall be as per Quality Assurance Programme in General Technical Conditions 2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.												

CLAUSE NO.	QUALITY ASSURANCE	<div>एनटीपीसी NTPC</div>												
	ELECTRICAL ACTUATORS WITH INTEGRAL STARTER													

PROCESS CONNECTION AND PIPING																		
ITEMS	TESTS	Visual ®	GA, BOM, Layout of component & construction feature®	Dimension ®	Paint Shade/thickness ®	Flattening, flaring, hydrotest, hardness check as per ASTM standard (A)	Component Ratings ®	Wiring ®	Make, Model, Type, Rating ®	IR & HV ®	Review of TC for instrument/devices (R)	Accessibility of TBs/Devices ®	Illumination,grounding ®	Tubing ®	Leak/Hydro test (A)	Chemical/physical properties of material (A)	Proof pressure test, Dismantling & reassembly test, Hydraulic impulse and vibration test (R)	Tests as per standards & specification
		Local Instrument enclosure	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y		
Local instruments racks		Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y			
Junction Box		Y	Y	Y	Y	Y*	Y	Y	Y	Y								
Gauge Board		Y	Y		Y	Y	Y				Y			Y	Y			
Impulse pipes and tubes		Y		Y	Y	Y			Y							Y		
Socket weld fittings ANSI B-16.11		Y		Y	Y				Y							Y		Y
Compression fittings		Y		Y	Y				Y					Y	Y	Y	Y	
Instrument valves & Valve manifolds		Y		Y	Y				Y					Y	Y	Y		
Copper tubings ASTM B75		Y							Y									Y
* - applicable for painted junction boxes. Note: R-Routine Test A- Acceptance Test Y - Test applicable																		
Note: This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.																		



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STANDARD QUALITY PLAN
FOR
FLOW ORIFICE PLATE ASSEMBLY

QUALITY PLAN NO.: PE-QP-999-145-1024

VOLUME IIB

SECTION D

REV. NO. 05 DATE: 30.05.13

SHEET 1 OF 2

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
1.0	MATERIAL											
1.1	Orifice Plate	1. Physical, Chemical properties	MA	Physical, Chemical Tests	One / Plate OR One/ Heat	AP / DS / SP	AP / DS / SP	Lab Report	3/2	---	2,1	IBR certification (if applicable) to be verified by BHEL
		2. Dimensions	MA	Measurement	100%	AP	AP	IR	3/2	---	1	
1.2	Flanges											
	A. Forgings	Chemical, Mech Properties, UT & Heat Treatment	MA	Chem & Mech UT test	Sample	Material Spec as per ASTM A 388 for UT	ANSI B 16.34	MTC, UT cert, HT cert	3/2	---	1	
	B. Machining	Dimensions	MA	Measurement	100 %	AP / DS	AP / DS	IR	3/2	---	1	
2.0	IN PROCESS											
	Machine	1. Dimension	MA	Measurement	100%	AP	AP	IR	3/2	2	2	
		2. Surface finish	MA	Visual	100%	-----	Mirror Finish	-----	3/2	2	---	
		3. Surface flaw on machined surface	MA	Penetrant test	100%	ASTM 165 / IS:3658	No surface flaw	IR / TC	3/2	2	1	
3.0	ASSEMBLY and FINAL INSPECTION											
		1. Overall dimensions	MA	Measurement	100%	AP	AP	IR	3/2	2,1	---	
		2. Marking, Tag no. Direction of flow	MA	Visual	100%	AP / DS	AP / DS	IR	3/2	2	1	
		3. Calibration	MA	Performance Test	One per type	-----	SP	TC	3/2	---	1	
		4. Painting	MA	Visual	100%	SP / MS	SP / MS	IR / MR	3/2	-----	1	

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics
IR - Inspection Reports
TC - Test Certificates
AP - Approved Drawings/doc
DS - Data Sheet
SP - Tech. Spec.

MR- Manufacturer records
MS- Manufacturer standards

^{\$} P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor



STANDARD QUALITY PLAN
FOR
FLOW ORIFICE PLATE ASSEMBLY

QUALITY PLAN NO.: PE-QP-999-145-I024		
VOLUME	IIB	
SECTION	D	
REV. NO.	05	DATE: 30.05.13
SHEET	2	OF 2

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
4.0	PACKING	Soundness of Packing against transit damage	MA	Visual	100%	SP / MS	SP / MS	----	3/2	----	----	Refer Note 4

NOTE:

1. All test reports & dimension reports shall be verified by BHEL wherever verification is by BHEL at the time of Final Inspection.
2. Minimum 2 coats of primer paint to be applied before dispatch.
3. CALIBRATION Test to be carried out at IIT-DELHI / FCRI or BHEL approved laboratory.
4. Sea Worthy packing, if applicable.

LEGEND: * CR - Critical characteristics IR - Inspection Reports DS – Data Sheet MR- Manufacturer records ^{\$} P - Agency Performing the Test. 1 - BHEL
MA - Major characteristics TC - Test Certificates SP – Tech. Spec. MS- Manufacturer standards W - Agency Witnessing the Test. 2 - Vendor
MI - Minor characteristics AP – Approved Drawings/doc V - Agency Verifying the Test. 3 - Sub-vendor



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STANDARD QUALITY PLAN FOR FLOW NOZZLE ASSEMBLY

QUALITY PLAN NO.: PE-QP-999-145-1005		
VOLUME	IIB	
SECTION	D	
REV. NO.	05	DATE: 30.05.13
SHEET	1	OF 3

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
1.0	RAW MATERIAL Flow Nozzle, pipe, adapter	Physical, Chemical properties	MA	Physical, Chemical tests	One / Heat	AP / DP / SP	AP / DP / SP	TC	3/2	---	2,1	Refer Note-1
		Ultrasonic testing (nozzle only)	MA	Ultrasonic test	100%	ASTMA388 & ANSI B 16.34	ASTMA388 & ANSI B 16.34	TC	3	2	1	
2.0	IN PROCESS											
2.1	Welding procedure specification (WPS)	Correctness	MA	Scrutiny	100%	IS:7307 / ASME IX	IS:7307 / ASME IX	Format of IS / ASME	3/2	---	2,1	IBR certification to be verified by BHEL, if applicable Welding to be done by qualified welders. Refer Note-3 100% by Vendor, 10 % by BHEL Films to be reviewed by BHEL.
2.2	Procedure Qualification Record(PQR) & Welders qualification	Weld soundness	MA	Physical test / Radiographic Test	IS:7307/ IS:7310/ ASME IX	IS:7307/ IS:7310/ ASME IX	IS:7307/ IS:7310/ ASME IX	Format of IS / ASME	3/2	2	1	
2.3	Weld FIT-UPS	Dimension, Alignment, Orientation.	MA	Measurement & Visual	100%	WPS/Approved drg.	WPS/Approved drg.	IR / Log Book	3/2	---	2	
2.4	Weldments final run	1. Surface defects	MA	Penetrant Test	100%	IS:3658 / ASTM 165/ ASME VIII Div. I	ASTM. / 165ASME VIII Div I	IR / Log Book	3/2	2	1	
		2. Sub Surface defects(After PWHT)	MA	Radiographic Test	100%	ASME SEC. V	ASME SEC. VIII	IR	3/2	2	1	

LEGEND: * CR - Critical characteristics IR - Inspection Reports DS - Data Sheet MR- Manufacturer records ^{\$} P - Agency Performing the Test. 1 - BHEL
 MA - Major characteristics TC - Test Certificates SP - Tech. Spec. MS- Manufacturer standards W - Agency Witnessing the Test. 2 - Vendor
 MI - Minor characteristics AP - Approved Drawings/doc V - Agency Verifying the Test. 3 - Sub-vendor



STANDARD QUALITY PLAN FOR FLOW NOZZLE ASSEMBLY

QUALITY PLAN NO.: PE-QP-999-145-1005		
VOLUME	IIB	
SECTION	D	
REV. NO.	05	DATE: 30.05.13
SHEET	2	OF 3

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
		3 Heat Treatment	MA	Review of HT Chart	100%	ASME SEC. VIII	ASME SEC. VIII	HT Chart	3/2	2	1	100% by Vendor, 10% by BHEL
2.5	Machining											
	1. Flow Nozzle (machined)	1. Dimensions	MA	Measurement	100%	AP / DS	AP / DS	IR	3/2	2	1	
		2. Profile	MA	Measurement	100%	AP / DS	AP / DS	IR	3/2	2	1	
		3. Surface finish	MA	Visual	100%	-----	Mirror finish.	IR / Mfd Records	3/2	2	1	
	2. Pipe, Adapter	1. Machining of pipe ID	MA	Measurement	100%	AP / DS	AP / DS	IR	3/2	2	1	
		2. Dimensions	MA	Measurement	100%	AP / DS	AP / DS	IR	3/2	2	1	
		3. Surface flaw on weld edge preparation (for shop welding)	MA	Penetrant Test	100%	ASTM 165/ IS-3658	ASTM 165/ IS-3658	IR / TC	3/2	2	1	
		4. IBR Clearance	MA	Review	100%	IBR Compliance	IBR Compliance	Form III C	3/2		1	
3.0	ROUTINE TEST	1. Leak tightness	CR	Hydraulic test (1.5 times Design pressure)	100%	AP / DS	No Leakage	Test Certificate	3/2	2,1	---	Minimum time duration of test shall be ½ hours.

LEGEND: * CR - Critical characteristics IR - Inspection Reports DS - Data Sheet MR- Manufacturer records ^{\$} P - Agency Performing the Test. 1 - BHEL
 MA - Major characteristics TC - Test Certificates SP - Tech. Spec. MS- Manufacturer standards W - Agency Witnessing the Test. 2 - Vendor
 MI - Minor characteristics AP - Approved Drawings/doc V - Agency Verifying the Test. 3 - Sub-vendor



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STANDARD QUALITY PLAN FOR FLOW NOZZLE ASSEMBLY

QUALITY PLAN NO.: PE-QP-999-145-1005		
VOLUME	IIB	
SECTION	D	
REV. NO.	05	DATE: 30.05.13
SHEET	3	OF 3

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
		2. Calibration	CR	Measurement	1 per type per size	----	Tech Spec.	TC	2	---	1	Refer note-4
4.0	FINAL ASSEMBLY	1. Marking – Tag No., direction of flow	MI	Visual	100%	AP / DS	AP / DS	IR	2	---	1	
		2. Workmanship, surface flaw on weld edge preparation on end of pipe (for site welding)	MA	Visual, Penetrant test	100%	ASTM165 / IS: 3658	No Surface Flaw	TC /IR	3/2	2	1	
		3. Overall Dimensions and end connection	MA	Measurement	100%	AP / DS	AP / DS	IR	3/2	2/1	---	Refer Note-2 before dispatch
5.0	PACKING & DISPATCH	Soundness of Packing against transit damage	MA	Visual	100%	SP / MS	SP /MS		2	---	---	Refer Note-5

NOTE:

- Test Certificates to be verified by BHEL at final inspection stage.
- Minimum 2 coats of primer paint to be applied before dispatch.
- In case of NTPC / LLOYDS / BHEL qualified welders available, then prequalification and WPS, PQR not required, only TC to be verified.
- CALIBRATION Test to be carried out at IIT-DELHI / FCRI or BHEL approved laboratory.
- Sea Worthy packing ,If applicable
- Qualification records of the Vendors can be verified.
- For P91 & P22 material welding should be continuously done. No interruptions shall be allowed.

LEGEND: * CR - Critical characteristics IR - Inspection Reports DS – Data Sheet MR- Manufacturer records ^{\$} P - Agency Performing the Test. 1 - BHEL
 MA - Major characteristics TC - Test Certificates SP – Tech. Spec. MS- Manufacturer standards W - Agency Witnessing the Test. 2 - Vendor
 MI - Minor characteristics AP – Approved Drawings/doc V - Agency Verifying the Test. 3 - Sub-vendor



QUALITY PLAN NO.: PE-QP-999-145-I 006

VOLUME	IIB
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SECTION	D
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REV. NO.	06	DATE:	05.09.2013
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SHEET 1 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
1.0	MATERIAL											
1.1	Body & Bonnet casting / forgings, plug, valve stem, seat ring/cage.	1. Physical, Chemical properties	MA	Physical, Chemical tests	One/ Heat(HT Batch)	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Test Certificate	3	---	2,1	
		2. Heat Treatment	MA	Review of H.T. Chart	Each H.T.	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Test Certificate	3/2	2	1	IBR Certification (if applicable) to be verified by BHEL
		3. Internal quality of castings	MA	RT for Body & UT for Bonnet(NDT)	100%	ASME B 16.34	ASME B 16.34	Test Report / FILM	3/2	2	1	Only for rating ANSI 900 and above. Applicable for Body and Bonnet only. For Lower rating only if called for in specification.
		4. Surface Quality	MA	1. Visual	100%	MSS-SP-55	MSS-SP-55	Test Certificate	3/2	---	2,1	
				2. MT/PT	100%	ASME B 16.34	ASME B 16.34	Test Certificate	3	2	1	After Machining on machined surface only

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

RT- Radiographic Test
UT – Ultrasonic Test

PT – Dye penetrant Test
MT- Magnetic Test

\$ P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor



STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)

QUALITY PLAN NO.: PE-QP-999-145-I 006	
VOLUME	IIB
SECTION	D
REV. NO.	06
DATE:	05.09.2013
SHEET	2 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
		5. Pressure test for shell	MA	Hyd. Test	100%	ISA-S-75.19/ ASME B 16.34	ISA-S-75.19/ ASME B 16.34	Test Certificate	2	2	1	For Body & Bonnet after machining
1.2	Diaphragm	1. Surface Quality	MA	Visual	100%	Mfr. standard	Mfr. standard	Test Certificate	3/2	---	2,1	
		2. Hardness	MA	Measurement	100%	Mfr. standard	Mfr. standard	Test Certificate	3/2	---	2,1	
		3. Endurance / Life cycle	MA	Cyclic test 10,000 cycles	One / Type	10,000 cycles/ Mfr. standard.	No damage	Test Certificate	3/2		2,1	
1.3	Spring	1. Composition	MA	Chemical-Analysis	One sample/ Heat	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
		2. Mech. Properties	MA	Mech. Test	One sample/ Heat	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
		3. Performance	MA	1. Stiffness ratio	100%	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
				2. Scragging	100%	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
				3. Cyclic test (Endurance)	One / type	10,000 cycles	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
				4. Dimension (Measurement)	One sample/ Lot	Mfr. standard	Appd Drg	Record	3	---	2,1	

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

RT- Radiographic Test
UT – Ultrasonic Test

PT – Dye penetrant Test
MT- Magnetic Test

[§] P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor



CONTROL VALVE (PNEUMATIC)

VOLUME	IIB
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REV NO 06

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 PEM :: C&I		STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)						QUALITY PLAN NO.: PE-QP-999-145-I 006				
								VOLUME IIB				
								SECTION D				
								REV. NO. 06 DATE: 05.09.2013 SHEET 4 OF 7				
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
3.1	Actuator Chamber	Leakage & Strength	MA	Pneumatic test	100%	Mfr. Standard	No Leakage	Test Certificate	2	1	1	Refer Note-4
3.2	Body	Leakage and Pressure test (Body Mount Leakage)	MA	Hydro test	100%	ISA - S-75.19	No Leakage	Test Certificate	2	1	1	Refer Note-4
3.3	Seat leakage test for completed valve	Seat Leakage	MA	Pneumatic Test	100%	FCI-70.2	FCI-70.2	Test Certificate	2	1	1	Refer Note-4
4.0	OPERATION TEST ON COMPLETED VALVE (Final inspection)	1. Valve Travel	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		2. Opening/Closing time	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		3. Linearity/cam characteristic	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		4. Repeatability	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		5. Hysteresis	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		6. Sensitivity	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		7. Accuracy (Overall)	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		8. Control Valve characteristics / CV Test	MA	♦ Measurement (Press. vs. discharge and discharge vs. opening 0-100% in steps of 10%)	One per type	As per specs/ Approved drg. / data sheet	As per specs/ Approved drg. / data sheet	Test Certificate	2	--	1	♦ Size = Body & port size Or Body size & CV for non std port. Refer Note 1.

LEGEND: * CR - Critical characteristics RT- Radiographic Test PT – Dye penetrant Test [§] P - Agency Performing the Test. 1 - BHEL MA - Major characteristics UT – Ultrasonic Test MT- Magnetic Test W - Agency Witnessing the Test. 2 - Vendor MI - Minor characteristics V - Agency Verifying the Test. 3 - Sub-vendor									
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CONTROL VALVE (PNEUMATIC)

VOLUME	IIB
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REV NO	06
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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
		9. Operation of limit switch & solenoids and other accessories	MA	Function	100%	Approved drg. / data sheet	As per specs/ Approved drg. / data sheet	Test Report	2	1	1	On assembled valve Refer Note-4
		10. Overall dimensions	MI	Visual and dimensional	100%	Approved drg. / data sheet	As per specs/ Approved drg. / data sheet	Records	2	1	1	Refer Note-4
		11. Pre defined valve position in case of air failure	MA	Visual	100%	As per spec & Appd drg	As per spec & Appd drg	Test Certificate	2	1	1	
		12. Cleanliness, painting, stamping (for direction of flow), Tag No.	MA	Visual and dimensional	100%	Approved drg. / data sheet	As per specs/ Approved drg. / data sheet	Test Certificate	2	1	1	
5.0	AUXILIARY ITEMS (Performance test of auxiliary items shall be performed on the completely assembled valve)											
5.1	Positioner	Overall leakage after assembly including Nozzles leakage	MA	Leak Test (in the steady state input signal)	100 %	Mfr. Standard	No leakage	Test Certificate	3/2	---	1	Overall leakage including tubing
5.2	Air filter regulator	1. Normal air consumption	MA	Measurement	Each type	Mfr. Standard	No leakage	Test Certificate	3/2	---	1	
		2. Overall leakage	MA	Visual (soap solution)	100 %	Mfr. Standard	No leakage	Test Certificate	3/2	---	1	
5.3	Air lock relay	Performance Test	MA	Leakage test	100%	Mfr. Standard	No leakage	Test Certificate	3/2	---	1	
5.4	Electronic position transmitter(not applicable if provided integral to smart positioner)	1. Accuracy	MA	Operation	100%	Approved data sheet /	Approved data sheet /	Test Certificate	2	1	1	

1 - BHEL
2 - Vendor
3 - Sub-vendor



CONTROL VALVE (PNEUMATIC)

VOLUME	IIB
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Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
5.5	Current to Pneumatic converter(not applicable for smart positioner)	1. Physical Verification Make/Model	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	---	2,1	
		2. Degree of Protection	MA	IP/NEMA test	Each type	Relevant Standard	Relevant Standard	Test Certificate	3	---	2,1	
		3. Linearity	CR	Measurement	100%	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Inspection Report	2	---	1	
		4. Hysteresis	CR	Measurement	100%	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Inspection Report	2	---	1	
5.6	Smart Positioner (As Applicable)	1. Physical Verification Make/Model	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	---	2,1	
		2. Degree of Protection	MA	IP/NEMA test	Each type	Relevant Standard	Relevant Standard	Test Certificate	3	---	2,1	
		3. Linearity	CR	Measurement	100%	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Inspection Report	2	---	1	
		4. Hysteresis	CR	Measurement	100%	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Inspection Report	2	---	1	
		5. Calibration with Hand Held Communicator	MA	Measurement	Each type	Approved data sheet / Mfr. Standard	Approved data sheet / Mfr. Standard	Test Certificate	2	1	1	
6.0	PAINTING	Soundness of Painting	MA	Visual and Measurement	100%	BHEL specn. / Mfr. Standard	BHEL specn. / Mfr. Standard	Inspection Report	2	---	---	Refer Note-2
7.0	PACKING	Soundness of Packing against transit damage	MA	Visual	100%	Mfr. Standard	Mfr. Standard	Inspection Report	2	---	---	Refer Note-3

1 - BHEL
2 - Vendor
3 - Sub-vendor

<div> PEM :: C&I</div>		STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)						QUALITY PLAN NO.: PE-QP-999-145-I 006				
								VOLUME IIB				
								SECTION D				
								REV. NO. 06		DATE: 05.09.2013		
								SHEET 7		OF 7		
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	

NOTES:

1. In case valid CV test certificate for a similar control valve(Same type, Same size, Same CV) is not submitted to BHEL by the vendor, CV test shall be conducted at FCRI/Any govt. approved laboratory/ BHEL approved Laboratory.
2. In the absence of BHEL spec. for painting, vendor to obtain BHEL's approval on their painting specification / procedure.
3. Sea worthy packing shall be provided, if applicable.
4. The quantum of check shall be 100% for manufacturer and 10% for BHEL/BHEL nominated inspection agency.
5. IBR certificates in Form III-C shall be submitted if called for in the specification/datasheet.
6. Copies of all TC's(Test Certificates) for materials duly correlated with Heat Nos., TC's for electrical items and mechanical tests(Leak/Operation) shall be submitted to BHEL for verification and acceptance.

LEGEND: *		CR - Critical characteristics	RT- Radiographic Test	PT – Dye penetrant Test	\$ P - Agency Performing the Test.	1 - BHEL
		MA - Major characteristics	UT – Ultrasonic Test	MT- Magnetic Test		2 - Vendor
		MI - Minor characteristics				3 - Sub-vendor



STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.: PE-QP-999-145-1056		
VOLUME	IIB	
SECTION	D	
REV. NO.	01	DATE: 22-02-2008
SHEET	1	OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
1.0	INCOMING Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	3	---	2	
		2. Bend Test	CR	Mech. test	Sample	IS:1079 IS:513	IS:1079 IS:513	Log Book	2	---	---	
		3. Surface finish	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		4. Waviness	MA	Visual	100%	Factory Standard	No Waviness	Log Book	2	---	---	
		5. Thickness	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	---	---	
		6. Mill marking	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	1	
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	IS:2062	IS:2062	Log Book	2	---	---	
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	---	---	
		4. Mill marking	MA	Visual	100%	IS:2062	IS:2062	Log Book	2	---	1	
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

^s P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor



STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.: PE-QP-999-145-1056		
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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
		3. Conductor a) Resistance b) Size c) Sheet colour	MA MA MA	Electrical Measurement Visual	100% 100% 100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	3	---	2	
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type 2. Verification of Test Certificates 3. Operation / Functional check 4. I.R. 5. H.V. 6. Calibration 7. Pick up / Drop off Voltage	CR CR CR MA MA MA MA	Visual Scrutiny of Type / Routine T.Cs. Electrical Electrical Electrical Electrical Electrical	Sample 100% Sample+ 100% 100% 100% 100% 100%	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	Log Book Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2 2	--- --- --- --- --- --- ---	--- --- --- --- --- --- ---	+ for relay & contactors only @ for all components except relays & contactors. 1

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make 2. Surface defects 3. IR / HV on Terminal Blocks	MA MA MA	Visual Visual Electrical	Sample Sample Sample	BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue	Log Book Log Book Log Book	2 2 2	--- --- ---	--- --- ---	
6.0	IN PROCESS Blanking / Bending / Forming	1. Dimensions 2. Surface defects after bending	MI MA	Measurement Visual	100% 100%	Approved Mfr. drgs. Factory Standard	Approved Mfr. drgs. Factory Standard	Log Book Log Book	2 2	--- ---	--- ---	
7.0	Nibbling / Punching	1. Cutout Sizes 2. Deburring	MI MA	Measurement Visual	100% 100%	Approved Mfr. drgs. Approved Mfr. drgs.	Approved Mfr. drgs. Approved Mfr. drgs.	Log Book Log Book	2 2	--- ---	--- ---	
8.0	ASSEMBLY Frame Assembly & Sheet fixing	1. Dimensions 2. Alignment 3. Welding Quality 4. Surface defects	MA MA MA MA	Measurement Measurement Visual Visual	100% 100% 100% 100%	Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards	Log Book Log Book Log Book Log Book	2 2 2 2	--- --- --- ---	2 2 2 2	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		4. Surface quality after every dip	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		6. Putty Application & Rubbing after primer	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		3. Ferrule numbers	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		4. Colour of wiring	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
		5. Size of Conductor	MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
11.	Component Mounting	1. Correct components	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
		2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
12.	FINAL Final Inspection	1. Workmanship	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		3. Components identification Marking / Name plates	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		6. Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		7. Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		8. Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		9. Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	
		10. Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1	
		11. Wire Termination	MA	Pulling manually	Sample	-----	Firm termination	Inspection Report	2	1	1	
		12. Continuity	MA	Electrical	100%	-----	Continuity OK	Inspection Report	2	1	1	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	Type Test Certificate	3	---	1	
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant IS.	BHEL approved spec., drg., BOM & relevant IS.	Test Report	2	1	1	
15	FUNCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		2. Instrument Calibration	CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		3. Temperature rise	CR	Electrical	100%	BHEL approved spec/drg. & relevant IS.	BHEL approved spec/drg & relevant IS.	Inspection Report	2	1	1	


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										SHEET 1 OF 8		
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
1.0	Materials /Components											
1.1	Panels & Control Desks	Physical Inspection for Dimensions, Painting, Cutouts, Lifting / Locking Arrangements, Components, Drawing Pocket, Mounting accessories, Plinth & AV Pads, Cable Gland Plates, Hardwares, Hinges, Louvers & Filters, Fans & Panel Lamps	MA	Visual	100%	Contract specifications, Approved GA Drawings, BOQ	As per ref documents. No physical damage.	BHEL Quality Inspection Report.	3/2	2	1	
1.2	Power Supply/Packs, Battery & Battery charger, Transformer, UPS.	Physical Inspection Physical Damages Dimensions Mounting Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per reference documents, Test Report	BHEL Quality Inspection Report.	3/2	2	1	
1.3	Indicating Lamp, Annunciator, Meters, Transducers, Signal Converters, Instruments, Single Loop Controllers	Physical Verification Physical Damages Dimensions Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per ref documents No physical damage. Test/ Calibration report.	BHEL Quality Inspection Report	3/2	2	1	
1.4	PLC processors, I/O modules, Power Supply modules, Communication modules, Mounting Racks, Ethernet	Physical Inspection <ul style="list-style-type: none"> Identification Labels Physical Damages Quantity Spare Capacity 	MA	Visual	100%	Product Catalogue, Data sheets, Approved Configuration diagram, BOQ	As per ref documents. Test Certificates	BHEL Quality Inspection Report.	3/2	2	1	

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		STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER						QUALITY PLAN NO.: PE-QP-999-145-1036				
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								SHEET 2		OF 8		
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
1.5	CPU, Monitor, Keyboard, Mouse, CD Drives, Printers, OS, System Software, Engineering software in the form of Licensed CD.	Physical Inspection Identification Labels, Tech. Specification Physical Damages Accessories Installation arrangements for Computers & Printers	MA	Visual	100%	Contract specifications, Product Catalogue, Approved GA / Configuration drawing, BOQ.	As per reference documents.	BHEL Quality Inspection Report.	3/2	2	1	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
2.0	Assembly											
2.1	Functional Test for HMI/OWS devices such as Monitors, Keyboards, Mouse, Printers etc.	Operation	MA	Functional	100%	Approved Configuration Diagram & BOQ and FAT	Correct Operation of interconnected Devices of HMI system.	BHEL Quality Inspection Report.	2	1	1	
2.2	Hardware Functional Verification.	Physical arrangement, Wiring check & labeling, Continuity Checking, IR & HV test	MA	Visual/ Electrical	100%	Approved GA Drawing, Panel Wiring Diagram, IR & HV as per relevant International standard	Test Certification	BHEL Quality Inspection Report.	2	2	1	
2.3	Powering Up	Healthiness of all the modules/equipment, associated with Powering of PLC system	MA	Visual /Electrical	100%	Approved power supply scheme	All equipment to be healthy on power ON	BHEL Quality Inspection Report.	2	1	1	
2.4	Burn in test for PLC modules	Healthiness of PLC modules on Continuous Energisation, Temperature maintenance	MA	Visual/ Electrical	100%	FAT Procedure	Test certification as per FAT	BHEL Quality Inspection Report.	2	2	1	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
3.0	Factory Acceptance Test (FAT)											
3.1	Input Output Functional Verification	I/O configuration, I/O operation	MA	Visual/ Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.2	Processor Verification	Processor configuration, Powering up, standby operation (as applicable) and Loading	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.3	Power Supply Module Verification	Redundancy Operation	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.4	Communication System Verification	Redundancy operation of Communication System, Measurement of Response Time, Communication with third party system	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.5	Diagnostic Verification	Self Diagnostic features of PLC system	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.6	Control Panel/Desk Verification	Operation of PLC driven annunciation system, Mosaic, Push buttons & selector switches, Indicating lamps	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.7	Software Verification	(i) Control Logics (ii) Engineering Features (iii) HMI Features	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	

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FACTORY ACCEPTANCE TEST (FAT) PROCEDURE

This document covers procedure to conduct/witness PLC system functional tests in order to demonstrate conformity to purchase specifications and related engineering documents. The test shall be conducted at the system suppliers works. The system supplier shall conduct all functional tests before commencing FAT and test results shall be made available during FAT. Vendor must furnish following relevant drawings, duly approved by BHEL Engineering, for reference during FAT.

- a) Technical Specification of PLC.
- b) PLC System Configuration
- c) General Assembly Drawings.
- d) Panel Wiring Diagrams.
- e) Bill of Quantity for PLC System.
- f) Logic Diagram.
- g) HMI Schematics.
- h) Input / Output List.

Further the vendor shall furnish applicable product specification, datasheets, catalogues, test-certificates, and internal inspection records to enable FAT. Vendor shall also submit, [to the inspecting agency](#), his standard test procedure, for clauses given below; where vendor's standard practice has been referred.

APPLICABLE TEST PROCEDURE:

1. Input/Output Functional Verification.

Check for correctness of addressing of racks, slots and I/O modules as per applicable PLC configuration diagram. Appropriate signal generators shall be used to simulate Inputs and outputs to check operation and SCAN time. [Check online replacement of cards, processors, power supply etc.](#)

2. Processor Verification

PLC Configuration drawing to be referred for ascertaining

- i) Redundancy

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ii) Type (Hot or Cold)

Both the processors are to be checked for healthiness in case of redundant configuration as per vendor's standard practice. In case of hot redundancy, switchover of control from primary processor to standby processor shall be demonstrated for uninterrupted control and data processing as per vendor's standard practice. Switchover shall be witnessed, by manual power off or resetting the Primary CPU or simulating failure of primary processor. Checking should be by witnessing the lighting up of Processor's LEDs as per manufacturer's product standard.

Vendor shall demonstrate, as per Vendor's standard practice, adequate Loading (Spare Capacity) of Processors, as mentioned in contract specs. This shall be done, by simulating worst load operation of fully integrated PLC system.

3. Power Supply Module Verification

Check if PSM is in redundant mode as per specification. Check the healthiness of power supply from both the modules' lamp indication/measurement. Simulate failure of one PSM and verify that standby PSM has taken over without any interruption.

4. Communication System Verification

Communication system has to be in line with approved PLC Configuration Diagram. Verify that both the communication buses are intact and connected. Communication between PLC processors, I/O rack, OWS etc. is to be checked through simulation of input data. Simulate the bus failure by disconnection of working bus. Check that the communication continues without interruption or loss of data.

Following response times are to be demonstrated as per vendor's standard practice for conformance to contract specifications:

1. Screen update time
2. I/O scan time
3. SOE resolution time
4. Data transfer time with third party system using Communication Protocol as per Contract specification and as per quantum of data as per approved signal exchange list.

5. Diagnostic Verification

Product Catalogue/Literature shall be referred for checking of all diagnostic features. Hardware failure to be simulated by removing an I/O

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6. Control Panel /Desk Verification

- i) PLC driven annunciation system should be checked by alarm signal simulation.
- ii) Push Button and selector switch operation should be checked by verification of corresponding change of status of Data Base point.
- iii) Indicating lamp / MIMIC should be checked by corresponding Data Base point simulation.

7. Software Verification

- i). Control Logics:– Software switches, lamps and Analog sources shall be used for simulation of field conditions .Control logics shall be checked for its correct functionality as per approved logic schemes
- ii). Engineering features:-
 - a) Online changing of parameters, set points.
 - b) Online modification in Control Logic Diagrams.
 - c) Online configuration of Graphics, Trends, Logs, HSR.
- iii). HMI features:-
Check for configuration & operation of Graphics, Trends, Logs, HSR and Alarms, in the form of Displays and Printouts, by simulation of Inputs as per approved documents.

8. Burn in Elevated Temperature test

Electronic equipments shall be subjected to Burn in elevated temperature test as per the procedure detailed below:

- a) (i) PLC modules are kept at 50 Deg c under continuous energized condition for 48 hours.

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ii) 48 hours test period shall be divided into 4 equal time segment of 12 hours duration each. For every 12 hours duration segment, after lapse of first 11 hours 110% of nominal voltage shall be applied to the panel under test for a period of 30 minutes followed by application of 90% of nominal voltage for the next 30 minutes.

b) Assembled Panels with complete wiring shall be kept under continuous energized condition for 120 hours at ambient temperature. Temperature rise in panels should be below 10 Deg C above ambient.



**TECHNICAL SPECIFICATION FOR
HYDROGEN GENERATION PLANT
2 X 800 MW NTPC GADERWARA STPP STAGE-I**

SPEC NO. PE-TS-394-168-A001

VOLUME-IIB


SECTION

REV.NO.0


DATE

SHEET


LIST OF SUB-VENDORS

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		VOLUME II-B	
		SECTION	
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SUB VENDOR LIST FOR HYDROGEN GENERATION PLANT	
Main Equipment	Manufacturer/Sub-Vendor
Hydrogen gas generator with purification system	Approved Main supplier own make
Power supply rectifier	Neeltran/Amtek/Rapid USA / Jasper/Hind
Hydrogen Compressor	PPI USA / PDC Machines INC. USA / Burton Corblin / Seybert & Rahier/Gardner Denver
PLC	OMRON, Japan / SAIA / Rock well / GE Fanuc / Seimens / Schneider/Allen Bradley, USA
Transmitters	Rosemount / Torex / Jumo / Yokogawa / Honeywell
Combustible Gas Detector	Sierra Monitor, USA / Zellweger
Trace oxygen Analyser / Hydrogen analyser	Advance Instruments USA, E&H, Yokogawa, H&B, Emerson/Edgetech
Hygrometer	GE Sensing / Miechel Instruments/VAISALA USA
Portable H2 purity Analyser	Teledyne, USA / Gesellschaft Fur Geratebau mbH
Piping Materials(SS)	Sandvik Steel Co.USA/ Ratnamani, Ahemdabad/ Remi Mumbai
Piping Materials(CS)	Maharashtra Seamless, Mumbai/Jindal, Mumbai
Tube / Pipe Fittings	SWAGELOK / PARKER USA
Feed Water Tank	Hydromax,USA/Sharpeville, USA

	TITLE: TECHNICAL SPECIFICATION FOR HYDROGEN GENERATION PLANT 2X660 MW RAGHUNATHPUR TPP	SPEC. NO. PE-TS-390-168-A001	
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Annuciator/Control panel (refer note 4)	Internationally reputed make as per choice of Approvedmain supplier.
Solenoid valves	Asco,USA/ IMI Norgen Germany
Vacuum pump	Acmevac Sales Pvt. Ltd, Mumbai, India /NI Tech USA & S.Africa/Edwards Limited, UK/Gardner Denver Nash, China/Dicon, Mumbai Reputed
Hydrogen Dryer	Mellcon ENGS> PVT. LTD, New Delhi/Jindal Elect, Rourkee.
Cylinder test station	Indian compressors Limited, New Delhi, India/ Reputed
Hydrogen Filling Manifold	Misatu Weldquip Pvt. Ltd., Gujarat / Reputed
Nitrogen Manifold	Misatu Weldquip Pvt. Ltd., Gujarat / Reputed
N2 / H2 Cylinders	BPCL Allahabad India/ Everest Kanto Cylinder Ltd. India
Ventilation Equipment	khaitan / Flakt / CBDoctor / Marathon/ Kruger/Nicotra
Zenner Barrier	MTL / P+ F India / Reputed
Instrument Cable	Delton cables,Faridabad/paramountcables, Hhushkhera/ Reliance, banglore/Polycab, Daman/ Universal Cables, Satna/ Elkay Telelinks, New Delhi/ Cords, Bhiwadi.
415 V LT Switch gear	C&S, Noida/ Seimens LTD. Mumbai/Alstom LTD, Kolkatta/L&T Coimbatore or Munbai/ GE Indai, Banglore/ Schneider Electric India Pvt Ltd, Nasik.
Flame proof motors	KEC,_Hubli/CGL,_Ahmednagar/_Bharat_Bijli,_Mumbai_

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Compressor motors	CEMP, USA/ Lohar, Germany/ABB, Germany
LT Power Cables PVC Insulated	KEI, Bhiwadi/ Delton Cables, Faridabad/ Ravin Cables, Pune/ Cords Cables, Bhiwadi/ Polycab wires, Daman/ Radiant, Hyderabad/ UCL, Satana/ ICL, Rajpura/ HVPL, Faridabad/ Elkay Telelinks, Faridabad/ Finolex Cables, Pune/ Paramount, Alwar/ Torrent, Nadiad/ INCAB, Pune/ NICCO, Kolkata
LT Control Cables	ICL, Rajpura/ Paramount Cables, Alwar/ Radiant Cables, Hyderabad/ Polycab Wires, Daman/ UCL, Satana/Nicco, Kolkata/ FGI, Kolkata/ Torrent, Nadiad/ Cords Cable, Bhiwadi/ Elkay Telelinks, Hyderabad/ Delton Cables, Faridabad/ HVPL, Faridabad
Instrumentation cables, Special cables (Refer Note 1)	Kerpen cables, Germany/ Lapp Cables, Germany/ Thermo Electra B V, Netherlands/ Thermoelectric, USA
PVC FRLS	Reliance Engineers, Bangalore/ Polycab, Daman/ Nicco, Kolkata/ Paramount cables, Alwar/ Delton, Faridabad/ INCAB, Pune
Cable Trays & Access	Vatco, Mumbai/ Indian Perforators Unistar Galv., Kolkata/ Anand Udyog, Mumbai/ Indiana+Karamtara Galv., Mumbai/ Jamuna Metal, Delhi/ Dolphin (Fabrication by INAR), Ankapally, Stellite Engg, Mumbai/ Unitech Fabricators, Kolkata
Cable tray Flexible Support system	Stellite Engg., Mumbai/ Am Tech + BG Shirke galv., Pune/ Vatco, Mumbai/ Dolphin, Ankapally/Comet, Mumbai
Cable Glands	Sunil & Co., Kolkata/ QPIE, Kolkata/ Arup Engineering, Kolkata/ Commet, Mumbai
Lugs	Dowell, Mumbai/Chetna, Nasik
Luminaries & Lamps	CGL, Mumbai/ Philips, Kolkata/ Bajaj, Mumbai
Lighting Panel (Wall mounted)	Positronics, Baroda/ Pyrotech, Udaipur
Flame proof lighting fixtures, JB, PB	Baliga, Chennai/Ajmera, Mumbai/Flexpro, Navsari
Lighting wires as per IS 694	BIS approved source
Cooling water control Valve	Bellito Air Controls Inc., USA, Emerson France, WEIR valves, UK/ Dresser Mesonilan, France/ Copes Valcun

	TITLE: TECHNICAL SPECIFICATION FOR HYDROGEN GENERATION PLANT 2X660 MW RAGHUNATHPUR TPP	SPEC. NO. PE-TS-390-168-A001	
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Pressure Transducer	Barksdale, USA/Camille Bauer, Switzerland/ Metrawatt, Germany
Valves Gate, Globe, Check (15 NB to 250 NB) (up to 2500 Class)	TOA Valves, Japan/ Deutsche Babcock, Germany/ Dresser, USA
Valves Gate, Globe, NRV (15 NB to 250 NB) (up to 800 Class)	Audco, Chennai/ BDK, Hubli
Check valves	NUPRO, USA
Level Transmitter (Displacer type)	Dresser Mesonelan, France/ Yamatake Honeywell/ Japan, ECKORDT, Germany/ Dresser, USA
Level Transmitter (Capacitance type)	Magnetrol, Belgium/ E&H, Germany
Pressure Gauges	Swagelok, USA/Alecandria WIKA, Germany/ Dresser Aschcroft, USA/ Budenburg, UK
Pressure switches, Temperature switch, DPS	NEODYN, USA/Delta, UK/ ITT Barton,USA/ KDG, UK/ Dresser,USA/ SOR, USA/Herion, Germany
Differential pressure Indicators	ITT Baron, USA/Budenburg, UK/ Switzer/ Dresser Ashcroft,USA
Computers	DELL/COMPAQ/HP/LENOVO
Printers	HP/CANON/Xerox/SAMSUNG
Air Conditioner	Carrier/LG/HITACHI/BLUE STAR (Minimum 4 star BEE rated Split AC reqd.)
Ventilation Fans	Marathon Electric/Khatan/ABB/Alstom/Bajaj

Note:- All the finally selected sub vendors shall be subject to customer approval during detailed engineering without any delivery/commercial implications to BHEL.



**TECHNICAL SPECIFICATION FOR
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2 X 800 MW NTPC GADERWARA STPP STAGE-I**

SPEC NO. PE-TS-394-168-A001

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PAINTING SCHEME DETAILS

CLAUSE NO.	TECHNICAL REQUIREMENTS	<div>एनटीपीसी NTPC</div>		
15.00.00	SPECIFICATION FOR SURFACE PREPARATION & PAINTING			
15.01.00	Surface preparation methods and paint/primer materials shall be of the type specified herein. If the contractor desires to use any paint/primer materials other than that specified, specific approval shall be obtained by the contractor in writing from the employer for using the substitute material.			
15.02.00	All paints shall be delivered to job site in manufacturers sealed containers. Each container shall be labeled by the manufacturer with the manufacturer's name, type of paint, batch number and colour.			
15.03.00	Unless specified otherwise, paint shall not be applied to surfaces of insulation, surfaces of stainless steel/nickel/ copper/brass/ monel/ aluminum/ hastelloy/lead/ galvanized steel items, valve stem, pump rods, shafts, gauges, bearing and contact surfaces, lined or clad surfaces.			
15.04.00	All pipelines shall be Colour coded for identification as per the NTPC Colour-coding scheme, which will be furnished to the contractor during detailed engineering..			
15.05.00	SURFACE PREPARATION			
15.05.01	All surfaces to be painted shall be thoroughly cleaned of oil, grease and other foreign matter. Surfaces shall be free of moisture and contamination from chemicals and solvents.			
15.05.02	<p>The following surface schemes are envisaged here. Depending upon requirement any one or a combination of these schemes may be used for surface preparation before application of primer.</p> <p>SP1 Solvent cleaning</p> <p>SP2 Application of rust converter (Ruskil or equivalent grade)</p> <p>SP3 Power tool cleaning</p> <p>SP4 Shot blasting (shot blasting shall be used as surface preparation method for hot worked pipes prior to application of primer)</p> <p>SP4* Shot blast cleaning/ abrasive blast cleaning to SA21/2 (near white metal) 35-50 microns</p> <p>SP5 Phosphating</p> <p>SP6 Emery sheet cleaning/Manual wire brush cleaning.</p>			

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
15.06.00	APPLICATION OF PRIMER/PAINT			
15.06.01	The paint/primer manufacturer's instructions covering thinning, mixing, method of application, handling and drying time shall be strictly followed and considered as part of this specification. The Dry film thickness (DFT) of primer/paint shall be as specified herein.			
15.06.02	Surfaces prepared as per the surface preparation scheme indicated herein shall be applied with primer paint within 6 hours after preparation of surfaces.			
15.06.03	Where primer coat has been applied in the shop, the primer coat shall be carefully examined, cleaned and spot primed with one coat of the primer before applying intermediate and finish coats. When the primer coat has not been applied in the shop, primer coat shall be applied by brushing, rolling or spraying on the same day as the surface is prepared. Primer coat shall be applied prior to intermediate and finish coats.			
15.06.04	Steel surfaces that will be concealed by building walls shall be primed and finish painted before the floor is erected. Tops of structural steel members that will be covered by grating shall be primed and finish painted before the grating is permanently secured.			
15.06.05	<p>Following are the Primer/painting schemes envisaged herein:</p> <p>PS3 - Zinc Chrome Primer (Alkyd base) by brush/Spray to IS104.</p> <p>PS3* - Zinc Chrome primer (Alkyd base) by dip coat.</p> <p>PS4 - Synthetic Enamel (long oil alkyd) to IS2932.</p> <p>PS5 - Red oxide zinc phosphate to IS-12744.</p> <p>PS9 - Aluminum paint to IS 2339.</p> <p>PS9* - Heat resistant Aluminum paint to IS-13183 Gr.-I (for temperature 400 °C - 600 °C) , IS-13183 Gr.-II (for temperature 200 °C - 400 °C) and IS-13183 Gr.-III (for temperature upto 200 °C)</p> <p>PS13- Rust preventive fluid by spray, dip or brush.</p> <p>PS14- Weldable primer-Deoxaluminatate or equivalent.</p>			

15.07.00 Primer/Painting Schedule

Sl. No	Description		Surface Preparation	Primer Coat			Intermediate Coat			Finish Coats			Total Min. Painting DFT (Microns)	Colour Shade
				System	Coat	Min. DFT / coat (Microns)	System	Coat	Min. DFT/ Coat (Microns)	System	Coat	Min. DFT/ Coat (Microns)		
1.	All insulated Pippings, fittings/ components, Pipe clamps, Vessels/Tanks, Equipments etc.		SP3/SP4	PS 9*	1	20	-	-	-	PS9*	1	20	40	As per NTPC Colour shade/ coding scheme
2.	All un-insulated Piping, fittings/ components, Pipe clamps, Vessels/Tanks, Equipments etc.	Design temperature <60 °C	SP3/SP4	PS 5	2	25	-	-	-	PS 4	3	35	155	
		Design temperature 60 °C-200 °C	SP3/SP4	PS 9*	1	20	-	-	-	PS9*	1	20	40	
		Design temperature > 200 °C	SP3/SP4	PS9*	1	20	-	-	-	PS9*	1	20	40	
3	Constant Load Hanger (CLH), Variable Load Hanger (VLH) and other supports		SP4*	PS19	1	40	-	-	-	PS17	1	30	70	

4.	Valves												
	Cast /Forged	Design temperature <60 °C	SP1/SP2/SP3	PS4/PS9	1	40	Polyamide Epoxy	1	100	PS17	1	40	180
		Design temperature 60 °C-200 °C	SP1/SP2/SP3	PS9*	1	20	-	-	-	PS9*	1	20	40
		Design temperature > 200 °C	SP1/SP2/SP3	PS9*	1	20				PS9*	1	20	40
5.	All Structural Steel components	Outside TG building and in SG envelope	SP4*	Inorganic Ethyl Zinc Silicate	1	75	PS18	1	75	a))Epoxy coat	2	35	250
										b)Final coat of paint PS17	1	30	
		Within TG building	SP4*	-do-	1	35	PS18	1	35	a))Epoxy coat	2	25	150
										b)Final coat of paint PS17	1	30	

6.	Weld Edges	SP6 (Hand cleaning by wire brushing)	PS13 (Welda ble primer)	1	25	-	-	-	-	-	-	-	
\$ The first 2 finished coats (total min.DFT of 70 microns) shall be done at shop and the 3 rd finish coat (min.DFT 35 Microns) shall be applied at site.													

17.00.00

Testing Requirements:

The detailed testing requirements for power cycle piping and its components are given in the subsection for Quality Assurance(QA) .The requirements pertaining to testing given in this subsection if in variance with that given in QA subsection, then the more stringent of the two shall be followed.



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DRAWING /DOCUMENT DISTRIBUTION SCHEDULE

DRAWING /DOCUMENT DISTRIBUTION SCHEDULE.

Documents: Cus	owner	Consultant	PS-ER	SITE	PEM
Documents for approval	5+1S	2+1S	2+1S	3	3+1S
Documents for information	5	2	2	3	3
Schedules, diagrams, lists, tables, calculation, specifications and other documents	5 2		2	3	2
Final as-built drawings	5 2		2	3	
CD-ROMs of final as-built drawings	5+2S	2+1S	2+1S	3	2+1S
Final as-built drawings (hard copy)	5	2	2	3	2
Final O&M manuals	5+2S	2+2S	2+1S	3+S	3+2S
CD-ROMs of Final O&M Manuals	5	2	2	3	2
Detailed project time schedules	5	2	2	3	1



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LIST OF DOCUMENT TO BE SUBMITTED

LIST OF DOCUMENT TO BE SUBMITTED AFTER LOI

SL. NO.	BHEL DRG NO	DRG TITLE	Document submission schedule (In Weeks)
1	PE-V7-390-168-A001	P&I DIAGRAM FOR H2 GENERATION PLANT WITH I/O LIST	4
2	PE-V7-390-168-A002	EQUIPMENT LAYOUT OF H2 GENERATION PLANT	4
3	PE-V7-390-168-A003	SUB VENDOR LIST HYDROGEN GENERATION PLANT	4
4	PE-V7-390-168-A004	EQUIPMENT FOUNDATION AND FLOOR DRAIN DETAILS OF H2 GENERATION PLANT	6
5	PE-V7-390-168-A005	DESIGN & CONTROL PHILOSOPHY OF H2 PLANT ALONG WITH INTERLOCK AND LOGIC DIAGRAM	6
6	PE-V7-390-168-A006	DATA SHEET, GA & CIRCUIT DIAGRAM OF RECTIFIER TRANSFORMER	6
7	PE-V7-390-168-A007	QAP FOR RECTIFIER	6
8	PE-V7-390-168-A008	GA OF H2 AND N2 GAS MANIFOLD, CYLINDERS AND CYLINDER TESTING APPARATUS	6
9	PE-V7-390-168-A009	GA OF FEED WATER, KOH TANK AND GAS HOLDER	6
10	PE-V7-390-168-A010	QAP FOR FEED WATER, KOH TANK AND GAS HOLDER	
11	PE-V7-390-168-A011	GA OF ELECTROLYSER AND PURIFICATION SKID	6
12	PE-V7-390-168-A012	QAP FOR ELECTROLYSER AND PURIFICATION SKID	6
13	PE-V7-390-168-A013	ELECTRICAL LOAD DATA	8
14	PE-V7-390-168-A014	DATA SHEET, SLD, GA & CIRCUIT DIAGRAM OF MCC AND MLDB	10
15	PE-V7-390-168-A015	QAP FOR MCC AND MLDB	10
16	PE-V7-390-168-A016	DATA SHEET AND GA FOR COMPRESSORS WITH MOTOR	10
17	PE-V7-390-168-A017	QAP FOR COMPRESSOR WITH MOTOR	10
18	PE-V7-390-168-A018	DATA SHEETS FOR INSTRUMENTS	10
19	PE-V7-390-168-A019	DATA SHEET FOR ANALYSERS	10
20	PE-V7-390-168-A020	DATA SHEET OF VALVE	10
21	PE-V7-390-168-A021	QAP FOR VALVES	10
22	PE-V7-390-168-A022	PIPING LAYOUT FOR HYDROGEN GEN PLANT	10
23	PE-V7-390-168-A023	QAP FOR HYDROGEN GEN PLANT (BALANCE OF ITEMS)	10
24	PE-V7-390-168-A024	DATA SHEETS FOR PUMPS WITH MOTOR	12
25	PE-V7-390-168-A025	QAP FOR PUMPS WITH MOTOR	12
26	PE-V7-390-168-A026	DATA SHEET, GA AND WIRING DETAILS FOR PLC PANEL, BOM, PLC CONFIGURATION DIAGRAM	12
27	PE-V7-390-168-A027	QAP FOR PLC	12
28	PE-V7-390-168-A028	CABLE TRENCH / TRAY LAYOUT FOR HYDROGEN GENERATION PLANT WITH DETAILS OF CABLE TRAYS AND ACCESSORIES	12

29	PE-V7-390-168-A029	Lighting Design/ Layout for Hydrogen Generation Plant along with protection system	12
30	PE-V7-390-168-A030	DATA SHEET, GA AND WIRING DIAGRAM OF BATTERY CHARGER	12
31	PE-V7-390-168-A031	ERECTION PROCEDURE	16
32	PE-V7-390-168-A032	CABLE SCHEDULE	16
33	PE-V7-390-168-A033	ENGINEERING BOQ	20
34	PE-V7-390-168-A034	PG Test report for Hydrogen generation Plant	20
35	PE-V7-390-168-A035	O&M MANUAL OF H2 GEN PLANT	24

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

- Internet explorer version – Minimum Internet Explorer 7
- Internet speed – 2 mbps (Minimum preferred)
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked
- Vendor's Internal proxy setting should not block DMS application's link (<http://124.124.36.198/wrenchwebaccess/login.aspx>)



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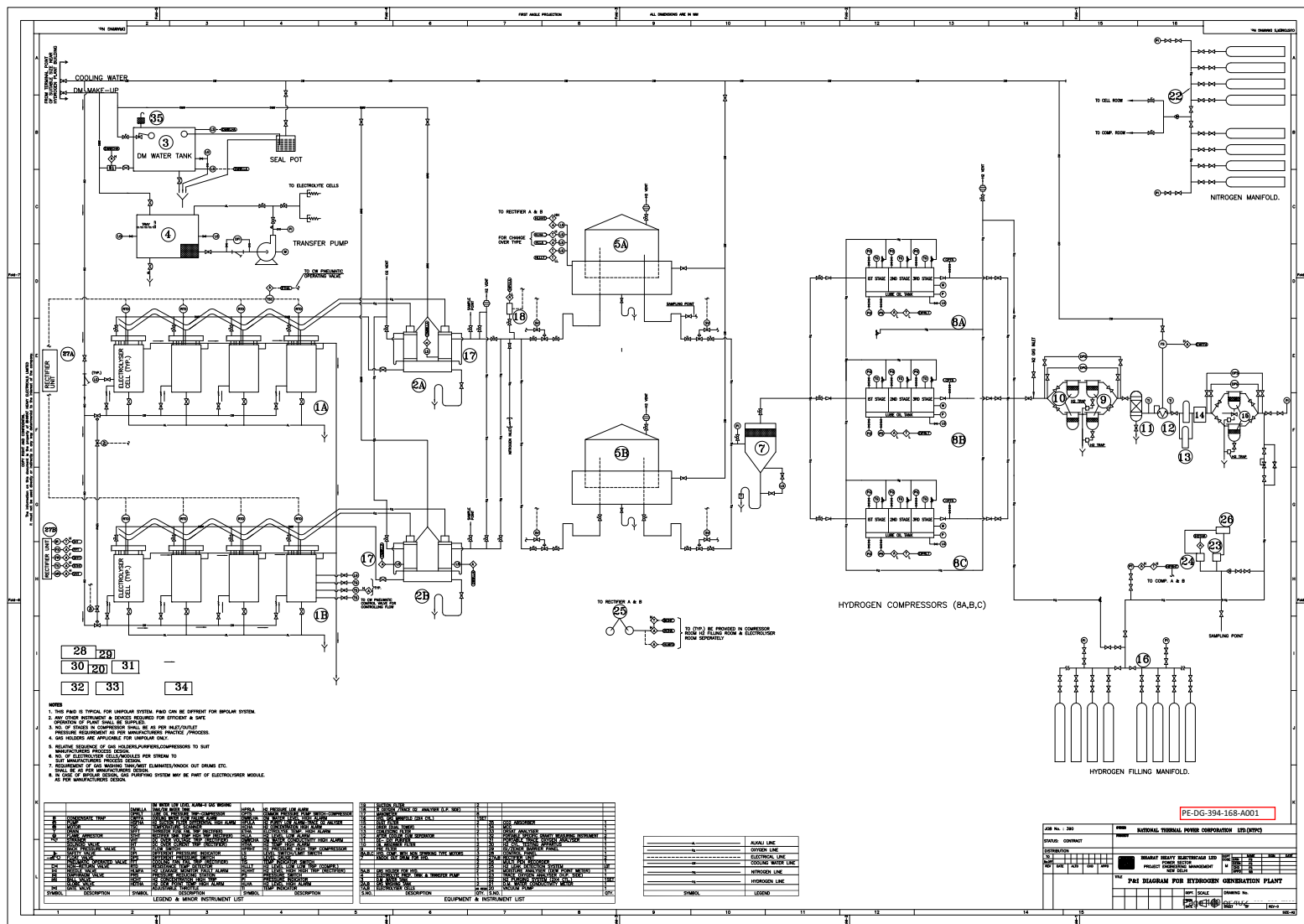
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P & I DIAGRAM





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LIST OF MANDATORY SPARES

CLAUSE NO.	MANDATORY SPARES		
SL. NO.	ITEM	QUANTITY	
5	DRIVE TURBINE OF BFP		
5.1	Emergency Stop Valve Assembly	1 No	
5.2	HP Control Valve Servomotor Assembly	1 No	
5.3	LP Control Valve Spares(1 set contains all internals for one valve excluding valve cover and body)	1 Set	
5.4	One Set Of Journal Bearings And Thrust	1 Set	
5.5	Emergency Stop Valve Servo Motor Assembly	1 Set	
6	ACW and ECW system		
6.1	Impeller for each type of pump	1 Set	
6.2	Pump shaft for each type of pump	1 Set	
III	EHC RELATED INSTRUMENTATION		
1.	Electro-Hydraulic Converter/Servo unit and position feed back transmitter for main turbine	1 Set	
2.	Electro-Hydraulic Converter/Servo unit and position feed back transmitter for LPBP	1 Set	
3.	Electro-Hydraulic Converter/Servo unit and position feed back transmitter for BFP Drive Turbine	1 Set	
	NOTE: All the governing spares are meant for EHC type governing system, in case of HP governing being offered, its equivalent spares should be offered		
IV	HYDROGEN GENERATION PLANT PLC System		
	a) Power Supply Module	20 % or 4 Nos. of each type and model, whichever is more.	
	b) Electronic IO modules	20 % of each type and model	

CLAUSE NO.	MANDATORY SPARES		
SL. NO.	ITEM	QUANTITY	
	c) CPU controller card	1 No. of each type	
	d) I) CPU communication modules to IO nodes(If applicable) II) CPU communication modules to HMI/OWS IO nodes (If applicable)	1 No. of each type 1 No. of each type	
V	CONDENSATE POLISHING UNITS RELATED SPARES		
1.00.00	MEASURING INSTRUMENTS		
1)	Electronic Transmitters		
	(i) Transmitters of all types and model. (for the measurement of Pressure, differential pressure, flow, level, etc.) including local indication (if applicable)	10 % or 1 no. of each type and model whichever is more	
2)	Temperature elements		
	(i) Temperature Transmitter	10 % or 1 no. of each type and model whichever is more	
	(ii) RTD's ^{1/2}	1 no. of each type	
	(iii) Thermo well ²	1 no. of each type	
	¹ (With head assembly, terminal block and nipple) ² (to be divided into various insertion lengths in proportion to main population)		
3)	Local Indicators (Non-Electrical type) -As applicable for the package as per the following items		
	(i) Temperature gauges	1 No. of each range and type	
	(ii) Pressure gauges	1 No. of each range and type	
	(iii) Differential Pressure Gauges,	1 No. of each range and type	
	(iv) Level gauges	1 No. of each range and type	
	(v) Flow gauges excluding Rota meters	1 No. of each range and type	

CLAUSE NO.	MANDATORY SPARES		
SL. NO.	ITEM	QUANTITY	
25	HYDROGEN GENERATION PLANT		
a)	Hydrogen gas analyzer		
	(i) Cast withdraw able electronic card temp. controller	1 set	
	(ii) Bridge mains unit	1 set	
	(iii) Temperature protection for heating elements	2 nos	
b)	Dew point meter		
	(i) Measuring device	1 no.	
	(ii) Special connection cable	30 meters	
	(iii) Amplifier(if applicable)	1 no.	
	(iv) Charts(if applicable)	100 nos.	
c)	Instrument spares		
	(i) Zenner barrier	2 nos.	
	(ii) Limit switch	5% of each type	
d)	Oxygen analyser sensor	1 no. of each type	
e)	Miscellaneous instruments.		
	(i) Pressure switches	1 no. of each type and rating.	
	(ii) Pressure gauges	1 no. of each type and rating.	
	(iii) Temperature gauge	1 no. of each type and rating	
	(iv) Flow indicators	1 no. of each type and rating.	
	(v) Differential pressure switch	1 no. each type and rating	
	One set means item required for replacement for one equipment.		

CLAUSE NO.	MANDATORY SPARES			
SL. NO.	ITEM	QUANTITY		
VIII.	MEASURING INSTRUMENTS			
1	(i) Guided wave RADAR for Hot well application	1 No.		
	(ii) Guided wave RADAR LP heaters	1 No. for each of the LP heaters		
2	Electronic Transmitters			
	(i) Transmitters of all type, range and model no. (for the measurement of Pressure, differential pressure flow, level, etc.)	10% or minimum 1 No. which ever is more		
	(ii) Electronic cards / PCB's for each type and model of transmitters.	10% of each type		
3	Temperature elements			
	(i) RTD's	10% of each type and length or minimum 1 No. which ever is more		
	(ii) Thermocouples	10% of each type and length or minimum 1 No. which ever is more		
	(iii) Thermo well for above applications	10% of each type and length or minimum 1 No. which ever is more		
	(iv) Temperature Transmitters	10%		
IX)	POWER SUPPLY SYSTEM			
	24 V DC power supply system			
	(i) Rectifier Modules	10% of each size/rating		
	(ii) Controller Module	10% of each type and model		
X)	CONTROL VALVES, ACTUATORS & ACCESSORIES			
1	Pneumatic and electro-hydraulic actuator assembly (other than Electro-hydraulic converter for LPBP, Main Turbine, BFP Drive Turbine)	10% or 2 Nos. of each type, model and rating, whichever is more.		
GAJMARA SUPER THERMAL POWER PROJECT, STAGE-I (2 X 800MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL SPECIFICATION SECTION-VI PART-A	MANDATORY SPARES	PAGE 18 OF 41

CLAUSE NO.	MANDATORY SPARES		
SL. NO.	ITEM	QUANTITY	
e)	Float for level regulator	1 No. (if applicable)	
f)	Filter elements	1 Set	
g)	Ferro-dynamic indicator	1 Set	
h)	Insulators for stator water header	1 Set	
33.4	HYDROGEN GENERATION PLANT		
a)	Motor for compressor	1 No.	
33.5	Motors		
a)	AC AOP motor for TDBFP	1 No.	
b)	AC JOP motor for TDBFP	1 No.	
c)	MDBFP lub oil pump motor	1 No.	
d)	Control fluid pump motor	1 no	
e)	Control fluid recirculation pump motor	1 no.	
f)	Control fluid leakage oil pump motor	1 no	
g)	Control fluid oil vapour exhaustor motor	1 no.	
h)	AC JOP motor for main turbine	1 no.	
i)	MOT centrifuge motor	1 no.	
j)	MOT oil vapour exhaustor motor	1 no.	
k)	TDBFP centrifuge motor.	1 no	
l)	TDBFP oil vapour exhaustor motor	1 no.	
m)	TDBFP transfer oil pump motor	1 no.	



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GUARANTEED POWER CONSUMPTION

GUARANTEED POWER CONSUMPTION

SL. NO.	MAJOR EQUIPMENTS NAME	TOTAL POWER CONSUMPTION (IN KW) TO OPERATE ONE STREAM (AT RATED CAPACITY) OF HYDROGEN GENERATION PLANT
1	ELECTROLYSER	
2	COMPRESSOR	



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**INFORMATION TO BE FURNISHED BY THE BIDDER
ALONG WITH BID**

DOCUMENTS TO BE FURNISHED ALONG WITH THE OFFER (4 SETS):-

1. Bidder to specify the deviations from the specification. If any, in the schedule of deviations enclosed as Volume-III, of technical specification. In the absence of duly filled in schedule, it will be presumed that the offer confirms to the specifications in all respects.
2. Electrical load data duly filled in. The format for electrical load is enclosed as annexure – 5, section C2 of technical specification.
3. Guaranteed power consumption duly filled in. The format for guaranteed power consumption is enclosed in section C1 of technical specification.
4. Bidder shall clearly bring out in the proposal the redundancy features along with configuration diagram and this shall be subjected to BHEL / Employer's approval during detailed engineering.
5. List of spares for:
 - Commissioning spares
 - Recommended spares
6. Any other details mentioned elsewhere.

HYDROGEN GENERATION PLANT


Clause No.	BIDDER'S NAME.....	
	HYDROGEN GENERATION PLANT	
1.00.00	TYPE OF PLANT	Unit Polar / Bipolar Type
1.01.00	GENERAL	
1.02.00	Manufacturer	
1.03.00	Guaranteed performance data	
1.03.01	Hydrogen generation Plant Capacity (NM ³ /hr)	.....
1.03.02	No. of Streams	.....
1.03.03	Capacity of each Stream	.....
1.03.04	Hydrogen Purity (%)	.....
1.03.05	Moisture content	.....
1.03.06	Whether the Plant System & equipments are designed as per the rules of Explosives Authority of India?	Yes/No
1.04.00	Whether the plant is designed for : –	
	i) Continuous duty ?	Yes/No
	ii) Parallel operation of streams ?	Yes/No
	iii) Operation of electrolyser in part Load ?	Yes/No
	iv) Operation from the control panel ?	Yes/No
	v) Flexibility of isolating of any cell of electrolyser and operation for rest of the streams ?	Yes/No
	vi) Automatic operation of standby compressors?	Yes/No
	vii) Automatic change over of gas holders ?	Yes/No

Clause No.	BIDDER'S NAME.....	
1.05.00	Whether complete instrumentation and control system provided as specified	Yes/No
1.06.00	Whether complete ventilation system as provided for no. of plants as specified	Yes/No
2.00.00	EQUIPMENTS A) Rectifiers i) Make & Model No. of rectifier ii) Type of rectifier iii) Rating in (KW) B) Electrolysers i) Manufacturer ii) Capacity of the electrolyser in (Nm ³ /hr) (Rated) iii) Pressure of hydrogen gas generated (Kg/cm ² (g)) iv) Temperature of hydrogen gas generated v) Consumption of electricity in KW/NM ³ of H ₂ C) Gas holders of Hydrogen and Oxygen i) No. of gas holders offered ii) Capacity and size of each gas holder (m ³)	
<div> <div>Hydrogen</div> <div>Oxygen</div> </div>		


Clause No.	BIDDER'S NAME.....	
	D) De-oxy-unit and gas cooler i) Manufacturer ii) Type iii) Capacity E) Hydrogen Gas drier i) Type ii) Make F) Compressors for Hydrogen i) Manufacturer ii) No. of compressor offered iii) Type of compressor iv) Delivery Pressure (Kg/cm ² (g)) v) Capacity (Nm ³ /hr) vi) Speed (rpm) vii) Type of drive viii) No. of stages of compressor G) Gas Filling Manifold i) No. of Manifolds ii) No. of filling points H) High pressure cylinder testing apparatus i) Manufacturer & Model No. ii) Rating of electric motor (KW)	


Clause No.	BIDDER'S NAME.....	
3.00.00	A) Cooling Water Required for Hydrogen Generation Plant per stream (M ³ /hr.)	.....
	B) Temperature rise (deg.C)	.....
4.00.00	DM water required for Hydrogen Generation Plant per stream (M ³ /hr.) at its rated capacity	.....


LT SWITCHGEAR


Clause No.	MOTORS	
	<p style="text-align: right;">..... (Bidder's Name)</p> <p>Applicable Data to be filled for each rating of HT, LT and DC motors</p> <p style="text-align: center;">MOTORS</p>	
1.00.00	GENERAL	
1.01.00	Manufacturer & Country of origin (Shall be as per approved QA make)	.....
1.02.00	Equipment driven by motor	.....
1.03.00	Motor type	.....
1.04.00	Quantity	.....
2.00.00	DESIGN AND PERFORMANCE DATA	
2.01.00	Frame size	.....
2.02.00	Type of duty	.....
2.03.00	Type of enclosure and method of cooling, Degree of protection	.....
2.04.00	Applicable standard to which motor generally conforms	.....
2.05.00	Type of mounting	.....
2.06.00	Direction of rotation as viewed from DE END	.....
2.07.00	Standard continuous rating at 40 deg.C. ambient temp. (KW)	.....
2.08.00	De rated rating for specified normal condition i.e. 50 deg.C ambient temperature (KW)	.....
2.09.00	Rated Voltage (volts)	.....
2.10.00	Permissible % variation of	
	a) Voltage (Volts)	.....
	b) Frequency (Hz)	.....
	c) Combined voltage and frequency	.....


Clause No.	MOTORS		<div>एनटीपीसी NTPC</div>
		<div>.....</div> <div>(Bidder's Name)</div>	
2.11.00	Minimum permissible starting Voltage (Volts)	<div>.....</div>	
2.12.00	Rated speed (RPM) at rated voltage and frequency	<div>.....</div>	
2.13.00	At rated Voltage and frequency		
	a) Full load current (Amps)	<div>.....</div>	
	b) No load current (Amps)	<div>.....</div>	
2.14.00	Power Factor at		
	a) 100% load	<div>.....</div>	
	b) NO load	<div>.....</div>	
	c) Starting	<div>.....</div>	
2.15.00	Efficiency at rated voltage and frequency,		
	a) 100% load	<div>.....</div>	
	b) 75% load	<div>.....</div>	
	c) 50% load	<div>.....</div>	
2.16.00	Starting current (amps) at		
	a. 100 % voltage	<div>.....</div>	
	b. 85% voltage	<div>.....</div>	
	c. 80% voltage	<div>.....</div>	
	d. Min permissible voltage	<div>.....</div>	
2.17.00	Starting time (secs) with minimum permissible voltage		
	a. Without driven equipment coupled	<div>.....</div>	
	b. With driven equipment coupled	<div>.....</div>	


Clause No.	MOTORS	
	<div style="text-align: right; margin-bottom: 10px;"> (Bidder's Name) </div> <div> <div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="width: 15%;">2.18.00</div> <div style="width: 60%;"> Safe stall time (secs) with 100% and 110% of rated voltage </div> <div style="width: 25%;"></div> </div> <div style="margin-left: 20px;"> a. From hot condition b. From cold condition </div> <div style="display: flex; justify-content: space-between; align-items: flex-start; margin-top: 10px;"> <div style="width: 15%;">2.19.00</div> <div style="width: 60%;"> Torques in Kg-m and in % of FLT </div> <div style="width: 25%;"></div> </div> <div style="margin-left: 20px;"> a. Starting torque at min. permissible voltage b. Pull up torque at rated voltage c. Pull out torque d. Min accelerating torque (kg.m) available e. Rated torque (kg.m) </div> <div style="display: flex; justify-content: space-between; align-items: flex-start; margin-top: 10px;"> <div style="width: 15%;">2.20.00</div> <div style="width: 60%;"> Stator winding DC resistance per phase (ohms at 20 Deg.C.) </div> <div style="width: 25%;"></div> </div> <div style="display: flex; justify-content: space-between; align-items: flex-start; margin-top: 10px;"> <div style="width: 15%;">2.21.00</div> <div style="width: 60%;"> GD2 value of motors </div> <div style="width: 25%;"></div> </div> <div style="display: flex; justify-content: space-between; align-items: flex-start; margin-top: 10px;"> <div style="width: 15%;">2.22.00</div> <div style="width: 60%;"> No of permissible successive starts when motor is in hot condition </div> <div style="width: 25%;"></div> </div> <div style="display: flex; justify-content: space-between; align-items: flex-start; margin-top: 10px;"> <div style="width: 15%;">2.23.00</div> <div style="width: 60%;"> a. locked rotor KVA input b. Locked rotor KVA/KW </div> <div style="width: 25%;"></div> </div> <div style="display: flex; justify-content: space-between; align-items: flex-start; margin-top: 10px;"> <div style="width: 15%;">2.24.00</div> <div style="width: 60%;"> Bearings <div style="margin-left: 20px;"> a. Type b. Manufacturer c. Self Lubricated or forced Lubricated </div> </div> <div style="width: 25%;"></div> </div> </div>	


Clause No.	MOTORS	
	<div style="text-align: right; margin-bottom: 10px;"> (Bidder's Name) </div> <div> <div>d. Recommended Lubricants</div> <div>e. Guaranteed Life in Hours</div> <div>f. Whether Dial Type thermometer provided</div> <div>g. Oil pressure Gauge/switch</div> <div> <div>i. Range</div> <div>ii. Contact Nos. & ratings</div> <div>iii. Accuracy</div> </div> </div>	
2.25.00	Vibration	
	a) Velocity (mm/s)	
	b) Displacement (microns)	
2.26.00	Noise level (DB) or Noise pressure	
	or Noise power	
3.00.00	CONSTRUCTIONAL FEATURES	
3.01.00	Stator winding insulation / Armature	
	winding insulation in case of	
	a. Class & Type	
	b. Tropicalised (Yes/No)	
	c. Temperature rise over	
	specified max.	
	i. Cold water temperature	
	of 39 DEG. C.	
	ii. Ambient Air 50 DEG. C.	
	(for air cooled motor)	
	d. Method of temperature	
	measurement	

Clause No.	MOTORS	
<p>3.12.00</p> <p>4.00.00</p>	<div style="text-align: right; margin-bottom: 10px;"> (Bidder's Name) </div> <p>Weight of</p> <p>a. Motor stator (KG)</p> <p>b. Motor Rotor (KG)</p> <p>c. Total weight (KG)</p> <p>LIST OF ACCESSORIES.</p> <p>a) RTDs for winding for HT motors (Type/Nos/Leads/ Location/make/Res.at 0 Deg.C)</p> <p>b) RTDs for bearing for HT motors (Type/Nos/Leads location/make/Res.at 0 Deg.C)</p> <p>c) RTDs for Hot Air for HT motors (Type/No/Leads)</p> <p>d) RTDs for Cold Air for HT motors (Type/No./Leads)</p> <p>e) Space Heaters for motors beyond 30KW rating</p> <p style="padding-left: 40px;">i) Nos.</p> <p style="padding-left: 40px;">ii) Power (Watts)</p> <p style="padding-left: 40px;">iii) Supply Voltage</p> <p>f) Stator Terminal Box (For HT motor)</p> <p style="padding-left: 40px;">i) Type</p> <p style="padding-left: 40px;">ii) Fault Level (MVA)</p> <p style="padding-left: 40px;">iii) Fault Level duration (secs)</p>	

Clause No.	MOTORS	
	<div style="text-align: right; margin-bottom: 10px;"> (Bidder's Name) </div> <div style="margin-bottom: 10px;"> g) Neutral TB for HT motors <div style="margin-left: 40px;"> i) Type </div> </div> <div style="margin-bottom: 10px;"> h) Current Transformer for HT motors <div style="margin-left: 40px;"> i) Nos. <div style="margin-left: 40px;"> ii) Ratio </div> <div style="margin-left: 40px;"> iii) Accuracy Class </div> <div style="margin-left: 40px;"> iv) Knee Point Voltage-V_k (Volts) </div> <div style="margin-left: 40px;"> v) Exciting Current </div> <div style="margin-left: 40px;"> vi) Max Secondary Resistance </div> </div> <div style="margin-bottom: 10px;"> i) Dial Type Thermometer for HT motors (Type/make/Accuracy/Connection type & size) <div style="margin-left: 40px;"> i) For Bearings (Nos.) <div style="margin-left: 40px;"> ii) For Air Temp (Nos.) <div style="margin-left: 40px;"> a. Hot Air <div style="margin-left: 40px;"> b. Cold Air </div> </div> </div> <div style="margin-left: 40px;"> iii) Contact Rating </div> <div style="margin-left: 40px;"> iv) Range </div> <div style="margin-left: 40px;"> v) Supply Voltage </div> </div> <div style="margin-bottom: 10px;"> j) Rotor Terminal Box </div> <div style="margin-bottom: 10px;"> k) TBs for RTDs. BTDs & Space Heater (Yes/No) </div> </div></div>	


Clause No.	MOTORS	
	<div style="text-align: right; margin-bottom: 10px;">..... (Bidder's Name)</div> <div> <div>l) Sole Plate (Yes/No)</div> <div>.....</div> <div>m) Foundation & Anchoring bolts (Yes/No)</div> <div>.....</div> <div>n) Base Frame (Yes/No)</div> <div>.....</div> <div>o) speed switch (Yes/No)</div> <div> <div>i) No of contacts and contact ratings of speed switch</div> <div>.....</div> </div> <div>p) Insulation of bearing (Yes/No)</div> <div>.....</div> <div>q) Forced oil lubrication (Yes/No)</div> <div>.....</div> <div>r) Oil level indicator (Yes/No)</div> <div>.....</div> <div>s) Noise reducer (Yes/No)</div> <div>.....</div> <div>t) Flow switch for CACW motor (Quantity)</div> <div> <div>i) No of contacts and contact ratings</div> <div>.....</div> </div> <div>u) Water leakage detector for HT motors</div> <div> <div>i) No of contacts and contact ratings</div> <div>.....</div> </div> <div>v) Grounding pads</div> <div> <div>i) No and size on motor body</div> <div>.....</div> <div>ii) Nos on terminal Box</div> <div>.....</div> </div> <div>w) Vibration pads</div> <div> <div>i) No and size</div> <div>.....</div> <div>ii) Location</div> <div>.....</div> </div> <div>x) Any other fitments</div> <div>.....</div> </div>	


Clause No.	MOTORS	
5.00.00	<div style="text-align: right; margin-bottom: 10px;"> (Bidder's Name) </div> <p>LIST OF CURVES</p> <p>i. Torque speed characteristic of the motor</p> <p>ii. Calibration characteristic of platinum type resistance temperature detector</p> <p>iii. Calibration characteristic of platinum BTM</p> <p>iv. Thermal withstand characteristic</p> <p>v. starting current Vs. Time</p> <p>vi. starting. current Vs speed</p> <p>vii. Neg. sequence current vs Time</p> <p>viii. P.F. and Effi. Vs Load</p> <p>Additional Data to be filled for each rating of DC Motor</p> <p>6.01.00 Rated armature voltage (Volt)</p> <p>6.02.00 Rated field excitation (Amp)</p> <p>6.03.00 Permissible % variation in voltage</p> <p>6.04.00 Minimum Permissible Starting voltage (volt)</p> <p>6.05.00 At rated voltage</p> <p>i) Full load Armature current. (Amp)</p> <p>ii) Full load Field current (Amp)</p> <p>iii) No load Armature current (Amp)</p> <p>6.06.00 Full load Field current (Amp)</p>	

Clause No.	MOTORS	
		..... (Bidder's Name)
6.07.00	No load Aramature current (Amp)	.....
6.08.00	Minimum permissible field current (Amp) to avoid overspeeding at	
	i) Maximum permissible voltage	.....
	ii) Rated voltage	.....
	iii) Minimum Permissible Voltage	.....
6.09.00	Resistance (indicative Values) in ohm	
	i) Armature winding (Arm + IP + Series) at 25 deg.C	.....
	ii) Field Winding at 25 deg. C	.....
6.10.00	Inductance (indicative values)	
	i) Armature winding	.....
	ii) Field winding	.....
6.11.00	Value of trimmer resistance (ohm) to be connected in series with the shunt field to obtain rated speed at	
	i) 220 V DC	.....
	ii) 250 V DC	.....
	iii) 187 V DC	.....
6.12.00	Value of the external resistance (ohm) required to be connected in series with armature during starting only	.....
6.13.00	Technical data sheet for external resistance box	.....
6.14.00	Terminal box arrangement	.....


Clause No.	MOTORS		<div>एनटीपीसी NTPC</div>
		<div>..... (Bidder's Name)</div>	
6.15.00	GA drawing of motor	.....
6.16.00	Starting time calculation	.....
6.17.00	Starter resistance design calculation	.....
6.18.00	Electrical connection diagram of motor	.....

POWER AND CONTROL CABLES


Clause No.	POWER AND CONTROL CABLES		
	..... (Bidder's Name)		
	POWER AND CONTROL CABLES (Use separate sheet for each type and size of cables)		
1.00.00	Make (Shall be as per approved QA make)	.....	.....
1.02.00	Country of Manufacturer	.....	.....
1.03.00	Type & designation	.....	.....
1.04.00	Applicable standard	.....	.....
1.05.00	Cable size & no. of cores	.....	.....
1.06.00	Rated voltage	.....	.....
1.07.00	Catalogue attached as Annexure No.	.....	.....
1.08.00	Continuous current rating for max. conductor temperature	.....	.....
	a) When laid in air at an ambient temperature of 50 deg. C	.....	.....
	b) When buried in soil having thermal resistivity of 150 deg.C cm/n at a depth of 1000 mm at ground ambient temperature of 40 deg. C	.....	.....
1.09.00	Short circuit withstand capacity and duration for	.....	.....
	a) Conductor	.....	.....
	b) Screen	.....	.....
	c) Armour	.....	.....
1.10.00	Conductor	.....	.....
	a) Material	.....	.....
	b) Nominal cross section area in sq. mm	.....	.....

Clause No.	POWER AND CONTROL CABLES		
		..... (Bidder's Name)	
1.11.00	c) Shape of conductor	.....	.....
	d) DC resistance at 20°C (Maxm.)	.....	.....
	Insulation		
	a) Material	.....	.....
	b) Nominal thickness (in mm)	.....	.....
	c) Type of curing (for XLPE)	.....	.....
1.12.00	Metallic screen (wherever applicable)		
	a) Material	.....	.....
	b) Type	.....	.....
	c) Short Ckt. (KA) & Period (Sec.)		
1.13.00	Material & Type of Inner sheath	.....	.....
1.14.00	Armour material & shape	.....	.....
1.15.00	Outer sheath material & type	.....	.....
1.16.00	Over all dia of cable (in mm)	.....	.....
1.17.00	Guaranteed value of minimum oxygen index of outer sheath	.....	.....
1.18.00	Maximum acid-gas generation by weight (%) of outer sheath	.....	.....
1.19.00	Smoke Density rating of outer sheath	.....	.....


CABLING EARTHING AND LIGHTNING PROTECTION

Clause No.	CABLING EARTHING AND LIGHTNING PROTECTION	
	<p style="text-align: right;">..... (Bidder's Name)</p> <p>CABLE SUPPORT SYSTEM</p> <p>1.00.00 Cable Trays, Fittings & Accessories</p> <p>1.01.00 Makers, Name, Country of manufacturer (Shall be as per approved QA make)</p> <p>1.02.00 Type & Material of cable tray</p> <p>2.00.00 Conduit Pipes & Accessories</p> <p>2.01.00 Maker's Name and Country of manufacture</p> <p>2.02.00 Material</p> <p>2.03.00 Class of duty</p> <p>2.04.00 Type of Coating</p> <p>2.05.00 Applicable Standard</p> <p>3.00.00 Junction Boxes</p> <p>3.01.00 Maker's Name and Country of manufacture</p> <p>3.02.00 Material</p> <p>3.03.00 Applicable Standard</p> <p>3.04.00 Degree of Protection</p> <p>4.00.00 Cable Glands</p> <p>4.01.00 Maker's Name and Country of manufacture</p> <p>4.02.00 Type of cable gland</p> <p>4.03.00 Applicable Standard</p> <p>4.04.00 Material</p>	


Clause No.	CABLING EARTHING AND LIGHTNING PROTECTION	एनटीपीसी NTPC	
	<p>(Bidder's Name)</p> <p>Cable lugs & Terminals</p> <p>5.01.00 Maker's Name & Country of Manufacturer</p> <p>5.02.00 Material</p> <p>5.03.00 Applicable Standard</p> <p>(i) HT</p> <p>(ii) LT</p> <p>6.00.00 Earthing System</p> <p>Equipment earthing</p> <p>i) Material</p> <p>ii) Size</p> <p>iii) Applicable Standard</p> <p>7.00.00 Lightning Protection System</p> <p>i) Applicable Standard</p> <p>ii) Size & material for Air termination and down conductor</p> <p>8.00.00 Cable Jointing/Termination Kits</p> <p>(a) Maker's Name & Country of Manufacturer</p> <p>(b) Type of System</p> <p>(i) Termination H.T./L.T.</p> <p>(ii) Joints H.T./L.T.</p> <p>(c) Outdoor/Indoor</p>		

Clause No.	CABLING EARTHING AND LIGHTNING PROTECTION	
9.00.00	<div style="text-align: right;"> <p>..... (Bidder's Name)</p> </div> <p>Cable Tray Support System</p> <ul style="list-style-type: none"> (a) Maker's Name, Country of Manufacturer (b) Type & Material of cable tray support system (c) Catalogue and indicative sketch attach as annexure No. 	


LIGHTING (H₂ GENERATION PLANT)

Clause No.	ELECTRICAL ACTUATOR																																																																																															
	<div style="text-align: right;">  </div> <div style="text-align: right;"> (Bidder's Name) </div>																																																																																															
	ACTUATOR DATA SHEET:																																																																																															
	<table border="1"> <thead> <tr> <th>Sl.No.</th> <th>Description</th> <th>Unit</th> <th>Data</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Actuator Manufacturer (Shall be as per approved QA make)</td> <td></td> <td></td> </tr> <tr> <td>2.</td> <td>Model</td> <td></td> <td></td> </tr> <tr> <td>3.</td> <td>Torque Range & RPM</td> <td>Kg-M</td> <td></td> </tr> <tr> <td>4.</td> <td>Duty Cycle (ON-OFF/Regulating)</td> <td></td> <td></td> </tr> <tr> <td>5.</td> <td>Local/Remote Selector Switch (Lockable)</td> <td></td> <td></td> </tr> <tr> <td>6.</td> <td>Enclosure/Degree of Protection</td> <td></td> <td></td> </tr> <tr> <td>7.</td> <td>Admissible Ambient Temperature</td> <td>°C</td> <td></td> </tr> <tr> <td>8.</td> <td>Average/Nominal Output</td> <td>KW</td> <td></td> </tr> <tr> <td>9.</td> <td>Rated Voltage</td> <td>V</td> <td></td> </tr> <tr> <td>10.</td> <td>Rated Frequency</td> <td>Hz</td> <td></td> </tr> <tr> <td>11.</td> <td>No. of Phases/No of Wires (3ph/3wires)</td> <td>Ph/Wires</td> <td></td> </tr> <tr> <td>12.</td> <td>Frame Size</td> <td></td> <td></td> </tr> <tr> <td>13.</td> <td>Admissible Voltage Variation</td> <td>%</td> <td></td> </tr> <tr> <td>14.</td> <td>Admissible Frequency Variation</td> <td>%</td> <td></td> </tr> <tr> <td>15.</td> <td>Admissible Combined Volt. & Freq. Variation</td> <td>%</td> <td></td> </tr> <tr> <td>16.</td> <td>Nominal Current (Average)</td> <td>A</td> <td></td> </tr> <tr> <td>17.</td> <td>Starting Current</td> <td>A</td> <td></td> </tr> <tr> <td>18.</td> <td>Full Load Speed</td> <td>RPM</td> <td></td> </tr> <tr> <td>19.</td> <td>Insulation Class</td> <td></td> <td></td> </tr> <tr> <td>20.</td> <td>Power Factor (Average Load)</td> <td></td> <td></td> </tr> <tr> <td>21.</td> <td>Average Load Efficiency</td> <td>%</td> <td></td> </tr> <tr> <td>22.</td> <td>Temp. Rise Over Ambient Temp. of 50°</td> <td>°C</td> <td></td> </tr> </tbody> </table>	Sl.No.	Description	Unit	Data	1.	Actuator Manufacturer (Shall be as per approved QA make)			2.	Model			3.	Torque Range & RPM	Kg-M		4.	Duty Cycle (ON-OFF/Regulating)			5.	Local/Remote Selector Switch (Lockable)			6.	Enclosure/Degree of Protection			7.	Admissible Ambient Temperature	°C		8.	Average/Nominal Output	KW		9.	Rated Voltage	V		10.	Rated Frequency	Hz		11.	No. of Phases/No of Wires (3ph/3wires)	Ph/Wires		12.	Frame Size			13.	Admissible Voltage Variation	%		14.	Admissible Frequency Variation	%		15.	Admissible Combined Volt. & Freq. Variation	%		16.	Nominal Current (Average)	A		17.	Starting Current	A		18.	Full Load Speed	RPM		19.	Insulation Class			20.	Power Factor (Average Load)			21.	Average Load Efficiency	%		22.	Temp. Rise Over Ambient Temp. of 50°	°C				
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20.	Power Factor (Average Load)																																																																																															
21.	Average Load Efficiency	%																																																																																														
22.	Temp. Rise Over Ambient Temp. of 50°	°C																																																																																														


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MOTORS


Clause No.	LIGHTING (H ₂ GENERATION PLANT)		
	 (Bidder's Name)	
11.00.00	Terminal Blocks		
	(a) Make	.....	.....
	(b) Type	.....	.....
	(c) Rating	.....	.....
12.00.00	Rigid steel Conduits/Fittings & accessories		
	(a) Make	.....	.....
	(b) Material	.....	.....
	(c) Applicable standard	.....	.....
13.00.00	Flexible steel conduit		
	(a) Make	.....	.....
	(b) Applicable standard	.....	.....
14.00.00	Lighting Wires		
	(a) Make	.....	.....
	(b) Applicable standard	.....	.....
	(c) Voltage grade	.....	.....
	(d) Size	.....	.....
	(e) Conductor material	.....	.....
	(f) Insulation	.....	.....
15.00.00	Type test reports of all items for Lighting enclosed at annexure no.	.....	.....


ELECTRIC ACTUATOR


CLAUSE NO.	BIDDER'S NAME	
1.00.00	LT SWITCHGEARS & LT BUSDUCTS	
	<p>SWITCHGEAR & MCC</p> <p>a) General</p> <p> i) Manufacturer's Name</p> <p> (Shall be as per approved QA make)</p> <p> ii) Type designation</p> <p> iii) Country of origin</p> <p>b) Rated voltage</p> <p>c) Symmetrical short circuit withstand current at rated voltage of switchgear /MCC cubicle.</p> <p>d) Peak short circuit withstand current</p> <p>e) Rated current at ambient</p> <p>f) Degree of protection as per IS:13947</p> <p> i) Breaker / MCC cubicles</p> <p> ii) Busbar chamber</p> <p>g) Cubicle sheet metal details</p> <p> i) Cold rolled / hot rolled</p> <p> ii) Thickness, structural & load bearing members</p> <p> iii) Thickness, front & rear</p> <p> iv) Thickness, Sides & top</p> <p> v) Thickness of gland plates</p> <p>h) Painting shade & Thickness as per IS :5</p> <p> i) External surfaces(front & rear)</p> <p> ii) Extreme end covers</p>	


CLAUSE NO.	BIDDER'S NAME	
2.00.00	<p>i) Minimum Clearance in air for Busbars</p> <p>i) Between phases</p> <p>ii) Between phase & earth</p> <p>j) Standard height, width & depth of typical panel</p> <p>i) Circuit breaker panel</p> <p>ii) MCC panels (S.F./D.F.)</p> <p>iii) Circuit breaker panel with Bus trunking /Bus Duct Termination</p> <p>iv) ACDB/DCDB</p> <p>v) AC/DC Fuse boards</p> <p>k) Width of cable alley</p> <p>l) Shrouding arrangement in cable alley provided or not YES/NO</p> <p>m) Earth busbar size & material</p> <p>n) Approx. Weight of one panel With circuit breaker</p> <p>o) Recommended dynamic loading for foundation design</p> <p>p) Approx. weight of one MCC panel</p> <p>POWER BUSBARS & INSULATORS</p> <p>a) Material & applicable standards</p> <p>b) Bare/painted / epoxy insulated/sleeved</p> <p>c) Continuous current rating at an ambient temp. of 50°C</p> <p>d) Temperature rise over design ambient temperature for continuous current rating deg. C</p> <p>e) Material of the support insulators</p> <p>f) One second current rating (kA)</p>	


CLAUSE NO.	BIDDER'S NAME	
	<p>o) Trip free and anti pumping features have been provided (Furnish description) YES/NO</p> <p>p) Power operating mechanism</p> <p>q) Spring charging motor details</p> <p> i) Type</p> <p> ii) Rating Watts</p> <p> iii) Rated voltage</p> <p> iv) Class of insulation</p> <p> v) Time for fully charging the closing spring</p> <p>r) Emergency Manual charging facility provided YES/NO</p> <p>s) Limits of voltage for satisfactory operation of the following devices as percentage of normal voltage</p> <p> i) Motor</p> <p> ii) Closing coil</p> <p> iii) Tripping coil</p> <p>t) Manual operating mechanism</p> <p>u) i) Type of Releases provided</p> <p> ii) Available range of following parameters for each type of release offered</p> <p>v) i) Maximum Tripping Time</p> <p> ii) Maximum Closing time</p> <p>w) i) Closing coil VA</p> <p> ii) Tripping coil VA</p> <p>x) Telescopic trolley</p> <p> i) Make</p>	

CLAUSE NO.	BIDDER'S NAME	
		
	ii) Type designation iii) Dimensions	
5.00.00	AIR BREAK SWITCHES (The following details shall be furnished for each type & rating) a) Make b) Type c) Applicable standards d) Rated current at design ambient temperature (Amps) e) Design ambient temperature Deg C f) Rated breaking current (kA) g) Maximum through fault current withstand kA h) Door interlock as specified has been provided ? YES/NO i) No. of auxiliary contacts and its rating	
6.00.00	CONTROL/SELECTOR SWITCH a) Make b) Type Designation c) Voltage grade	
7.00.00	CONTACTOR (The following details shall be furnished for each type and rating) a) Make b) Type & applicable standards c) Rated voltage of main and auxiliary contacts d) Rated voltage of coils	

CLAUSE NO.	BIDDER'S NAME	
8.00.00	e) Limits of operation i) Supply voltage variation +/-% ii) Supply frequency variation for closing (+/-)% iii) Drop out voltage % f) Rated (thermal) current A g) Rated duty h) Rated utilisation category as per IS:13947 i) Rated breaking capacity kA j) Rated making capacity - kA k) Coil VA burden	
	AUXILIARY CONTACTOR a) Make b) Type c) Catalogue attached as Annexure No.	
9.00.00	FUSES a) Make b) Type c) Category	
10.00.00	CURRENT TRANSFORMERS (The following details shall be provided for each type & rating) a) Make b) Applicable standards c) Ratio d) VA Rating	

CLAUSE NO.	BIDDER'S NAME	
15.00.00	c) Catalogue	
	AMMETER	
	a) Make	
	b) Type	
	c) Catalogue	
16.00.00	PUSH BUTTONS	
	a) Make	
	b) Type designation	
17.00.00	c) Catalogue	
	INDICATING LAMPS	
	a) Make	
18.00.00	b) Type	
	c) Catalogue	
	LOCAL STARTERS	
19.00.00	a) Make & Type	
	b) Catalogue	
	415 V NON SEGREGATED BUSDUCTS(If applicable)	
	a) Manufacturer's name & address	
	b) Type of busduct	
	c) Material and cross section of busbars	
	d) Rated voltage (volts)	
	e) Maximum voltage at which busduct can operate continuously (volts)	
	f) Continuous current rating of busbars (Amps)	
	g) Short circuit current ratings & duration (kA /Sec)	

CLAUSE NO.	BIDDER'S NAME	
20.00.00	<ul style="list-style-type: none"> h) Momentary current rating kA peak i) Temperature rise over the ambient temperature i) Busbars ii) Enclosures j) Material of support insulator k) No. and arrangement of support insulators l) Material of Gaskets m) One minute power frequency withstand voltage (kV) n) Minimum creepage distance over insulator (mm) o) Conductor treatment p) Clearance (mm) i) Phase to Phase ii) Phase to earth q) Average weight per meter of busduct (kg) r) Material and thickness of Busduct s) Shape & size of enclosure 	
	<p>LIGHTING / WELDING TRANSFORMERS</p> <ul style="list-style-type: none"> a) Make b) Voltage Ratio c) kVA Rating d) Vector Group e) Type of Cooling f) Percentage impedance g) Details of taps provided 	

CLAUSE NO.	BIDDER'S NAME	
21.00.00	h) Class of insulation	
	i) Degree of protection for enclosure	
	j) Whether mounted inside MLDB or outside	
	k) If it is mounted outside dimension of the enclosure	
	Metering Network and Energy Meters (For Motor>= 100 KW)(If applicable)	
	a) Energy Meters	
	i. Manufacturer's type designation	
	ii. Accuracy (Power and Energy)	
	iii. Input Voltage	
	iv. Input current	
	v. Mounting	
	vi. Communication (in Built 485 Port)	
	vii. Data recorded in Non-volatile memory	
	viii. Burden	
22.00.00	b) Type designation of RS 485 Converter	
	c) Type designation of LAN cable	
	d) Type Designation of Data Cable	
	Ethernet switches (For Networking of Numerical Relays)(If applicable)	
	a) Compliance to IEC 61850	
	b) No of Ports	
	c) Power supply to Ethernet Switches	



**TECHNICAL SPECIFICATION FOR
HYDROGEN GENERATION PLANT
2 X 800 MW NTPC GADERWARA STPP STAGE-I**

SPEC NO. PE-TS-394-168-A001

VOLUME-IIB

SECTION

REV.NO.0

DATE

SHEET

**SECTION C-2
SPECIFIC TECHNICAL REQUIREMENTS
(ELECTRICAL)**



ELECTRICAL EQUIPMENT SPECIFICATION
HYDROGEN GENERATION PLANT
2 X 800 MW NTPC GADERWARA STPP STAGE-I

SPEC NO. PE-TS-394-168-A001
VOLUME-IIB
SECTION
REV.NO.0 | DATE
SHEET

1. EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER :

- a) Services and equipment as per “Electrical Scope between BHEL and Vendor”.
- b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.
- c) Supply of mandatory spares as specified in the specifications of mechanical equipments.
- d) Erection and Commissioning spares.
- e) Erection & Maintenance tools & tackles.
- f) Electrical load requirement for Hydrogen generation plant.
- g) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- h) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer /BHEL approval without any commercial and delivery implications to BHEL.
- i) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.

2. EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS

Refer “Electrical Scope between BHEL and Vendor”.

3. DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/quality assurance requirements stipulated. In line with this two signed and stamped copies of the following shall be furnished by the bidder as technical offer:

- a) A copy of this sheet “Electrical equipment Specification for “Hydrogen generation plant” and sheet “Electrical Scope between BHEL and Vendor” with bidder’s signature and company stamp.
- b) List of Erection and Commissioning spares.
- c) List of Erection & Maintenance tools & tackles.
- d) Electrical load requirement

3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.



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ANNEXURE 4

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR
PACKAGE : HYDROGEN GENERATION PLANT

PROJECT : 2 X 800MW GADARWARA STPP

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	Vendor	Vendor	1. 415 V AC/240 V AC supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract including power supply equipment (battery charger etc) required for the PLC/control panel (as applicable) for the system supplied by vendor. 2. Interposing relays (RE 302 of Jyoti make or equivalent), if required for PLC and microprocessor based systems, shall be provided by BHEL in MCCs. Requirement of these relays shall be furnished by vendor during detailed engineering stage.
2	Local Push Button Station (for motors)	Vendor	Vendor	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	Vendor Vendor Vendor	Vendor Vendor Vendor	1. Sizes and quantity of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL). Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Laying of cables by vendor. 3. Termination at BHEL equipment terminals by BHEL. 4. Termination at Vendor equipment terminals by Vendor.
4	Any special type of cable like compensating, co-axial, prefab, MICC, fibre optical etc.	Vendor	Vendor	
5	Cable trays, accessories & cable trays supporting system	Vendor	Vendor	
6	Cable glands and lugs for equipments supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power cables 3. Solder less crimping type heavy duty copper lugs for control cables.
7	Conduit and conduit accessories for cabling between equipments supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537. Makes of conduits shall be subject to customer/ BHEL approval at contract stage.
8	Lighting	Vendor	Vendor	
9	Equipment grounding & lightning protection	Vendor	Vendor	
10	Below grade grounding	Vendor	Vendor	
11	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR
PACKAGE : HYDROGEN GENERATION PLANT

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
12	Mandatory spares	Vendor	-	Vendor to quote as per specification.
13	Recommended O & M spares, E & C spares, erection & maintenance tools & tackle.	Vendor	-	As per specification
14	Any other equipment/material/service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
15	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for C & I systems for vendor supplied equipment shall be furnished during detail engineering by vendor in soft copies in the BHEL cable schedule format.
16	Equipment layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipments requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Electrical equipment layout drawing shall be to BHEL approval.
17	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipments/items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.



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**ANNEXURE 5
ELECTRICAL LOAD FORMAT**

[illegible]



**TECHNICAL SPECIFICATION FOR
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SECTION – D1

**DESIGN REQUIREMENTS
MECHANICAL**

NOTE: Some of the design requirement specified in section D1 may not be relevant to the bidder design. Only the requirements relevant for bidder's system shall be considered by the bidder.

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	HYDROGEN GENERATION PLANT			
1.00.00	GENERAL PLANT DESIGN CRITERIA			
1.01.00	To be designed for continuous, as well for as two shift or one shift operation.			
1.02.00	The scheme shall be based on manufacturer's standard. The scheme & construction details of equipment are described for hydrogen generation plant of unipolar design in this section. However, Bipolar designs are also acceptable, provided the same are of proven design from reputed manufacturers. Some of the components specified herein may not be applicable for bipolar design. For bipolar deisgn, the same need not be supplied if it is not applicable as per manufacturer's standard practice. However, for such bipolar design, all safety measures shall be provided in line with specification/ schematic drawing.			
1.03.00	Total Plant Capacity to be sized as follows :			
1.03.01	Leakage rate per generator	= "A" NM3/day		
1.03.02	Requirement of one generator filling	= "B" NM3.		
1.03.03	Number of TG Units	= C		
1.03.04	Hydrogen generation plant Capacity	= [C*1.5* A + B/30]/12 NM3/hr		
1.03.05	However total plant capacity shall not be less than 20 NM ³ /hr with two streams of 50% Capacity each of minimum 10 NM3/hr.			
1.04.00	Hydrogen purity to be maintained at gas manifolds 99.9%.			
1.05.00	Moisture content in hydrogen :- 0.05 gm/m ³ (max.)			
1.06.00	The Complete Hydrogen generation plant system, equipments, layout etc. shall be designed as per the Explosives Authority and the bidder shall obtain the approval from Chief controller of Explosives - India and other statutory authorities for the design and installation of the plant.			
2.00.00	GENERAL OPERATIONAL CRITERIA/PHILOSOPHY			
2.01.00	To be designed for Continuous duty.			
2.02.00	To be designed for parallel operation of both streams.			
2.03.00	Flexibility to operate electrolyser in part load.			

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
2.04.00	Complete operation from remote control panel/OWS.			
2.05.00	To trip the plant in case of high hydrogen level inside the building suitable numbers of hydrogen gas detectors to be provided by the bidder for each of the room.			
2.06.00	Set pressure to be maintained with help of back pressure regulation valve.			
2.07.00	Automatic operation of standby compressor as and when required.			
2.08.00	To provide alarm & tripping of compressor based on suction conditions.			
3.00.00	CONSTRUCTION DETAILS OF EQUIPMENT			
3.01.00	Electrolyser			
3.01.01	Modular type. Both bipolar and unipolar type of electrolyzers are acceptable.			
3.01.02	Cells in electrolyser shall be connected to each other. Further for unipolar design there shall be provision to isolate any one of the cells in electrolyser. The cells in electrolyser shall be of corrosion resistant material.			
3.01.03	The electrolyser to be designed to operate at part load of normal capacity without any disconnection and operation interruption and shall produce the hydrogen gas of specified purity and dryness.			
3.01.04	All measuring instruments, controllers and control valves shall be provided.			
3.01.05	Safety devices are to be provided on each collecting pipe to release gas pressure in case it goes above the limits.			
3.01.06	To be designed so that it can be dismantled, cleaned, and reassembled easily.			
3.01.07	Proper sealing shall be provided by the Bidder while crossing the wall to avoid any gas leakage to Rectifier Room.			
3.01.08	Each electrolyser shall be fitted with the following instrumentation.			
	<p>(a) In unipolar design one explosion proof temperature switch in each cell for electrolyser temperature high alarm on the control panel. In case of bipolar design one explosion proof temperature switch in each generator module for electrolyser temperature high alarm on the control panel.</p> <p>(b) A local pneumatic temperature controller, controlled through PLC, to maintain the electrolyser temperature to a preset value by controlling cooling water flow to the electrolyser through the temperature control valve.</p>			

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनडीपीसी NTPC		
	<p>(c) One temperature gauge for local indication for electrolyte temperature.</p> <p>(d) One off-line specific gravity measuring instrument.</p>			
3.02.00	Rectifier			
3.02.01	Two nos, of rectifier (one for each electrolyser) to cater the load of each of the electrolyser. The rectifier equipment shall be complete in all respects with air-cooled rectifier transformer, thyristor converter, electronic control and annunciation, fillers choke etc mounted in suitable panels.			
3.03.00	Gas washing Tanks (if applicable)			
3.03.01	One for each electrolyser with manometers at inlet and outlet, temperature gauge, level switches for controlling the level of DM water in the tank etc.			
3.04.00	Demineralised water tank			
3.04.01	One number tank of Capacity adequate for 5 days normal requirement of hydrogen gas generation on continuous basis at rated capacity of (minimum) 20 NM ³ /hr.			
3.04.02	To be fitted with removable drain connections, level switches/ transmitters, level indicators etc.			
3.05.00	Caustic solution mixing tank <ul style="list-style-type: none"> (i) Capacity - Suitable to fill one electrolyser (ii) Material - High Density PVC (iii) Accessories - Removable cover, motor operated pump, instrument as required (iv) Pump (if applicable) - Suitable to pump alkali upto the cells with discharge flexible hose, differential pressure gauge across suction filter, pressure gauge at pump discharge etc. 			
3.06.00	Hydrogen gas Holders (if applicable) <ul style="list-style-type: none"> (i) Number Two (2) numbers (one for filling, one for supply to compressor) (ii) Capacity Each Gas holder shall be equal to that of hydrogen generation plant capacity or minimum of 20 NM³/hr (whichever is higher). 			

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	<p>(iii) Material IS-2062/2002 or equivalent</p> <p>(iv) To be designed for outdoor duty</p> <p>(v) To provided with two (2) Seal pots for each gas holders</p> <p>(vi) Accessories such as Wire rope, Counter weight, guide pulley required to suspend the gas holders, steel stairs four-way motorised valves, flame proof low & high level switches for interlock and control, float type level indicators, etc.</p> <p>(vii) Venting of hydrogen shall be through flame arrestor.</p>			
3.07.00	De-oxy unit (if applicable)			
3.07.01	One number De-Oxy unit shall be provided to handle both the streams and capable to remove oxygen as impurity. The unit should have accessories such as heater with temperature control device, gas cooler, filter, necessary instruments etc			
3.08.00	<p>Hydrogen compressors and drives,</p> <p>(i) Number 3x50% as specified in the scope (two working & one standby)</p> <p>(ii) Capacity of each compressor shall be 125% of each stream capacity</p> <p>(iii) Design delivery Pressure 150 kg/cm² (g)</p> <p>(iv) Type Preferably Oil free, Piston or Diaphragm type.</p> <p>(v) Piston type Of proven design</p> <p>(vi) Diaphragm type Triple diaphragm failure detection system. The side and oil side diaphragms shall be of stainless steel.</p> <p>(vii) Drive cage As speciifed in relevant subsections (Electrical) of Technical Speciifcations.</p> <p>(viii) Activated carbon filters 2 x100% and required in case of oil lubricated compressor</p> <p>(ix) All metal to metal joints shall be provided with "O" rings of suitable grade material.</p>			

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	<p>(x) To provide auxiliaries such as built in relief valves, Pressure and temperature gauges after every compression stages, mechanical lubricator, built in automatic unloader devices, Water cooled inter coolers after every compression stage, flow switches, pressure gauges in coolant line, sight flow indicators in coolant line, V belt drive with pulleys, a transfer switch to allow operation of standby compressor automatically, suction filters, scrubber to remove any traces of entrapped electrolyte, separator and filters, suitable protection device to prevent suction of water from gas holders as a back-up to low level switch provided on the gas holders for compressor TRIP, Mist Eliminators One number on-line hydrogen purity analyser at the suction etc.</p> <p>(xi) To make arrangement for continuously monitoring hydrogen purity before compressor and before filling of gas into cylinders and to provide suitable alarm and automatic tripping of plant in case, hydrogen purity falls below the preset level.</p>			
3.09.00	Drying system for Hydrogen gas			
3.09.01	To provide twin tower Moisture separating columns of Regenerative design alongwith instruments.			
3.09.02	To provide valves arrangement to suit operation of one Column & another under regeneration. The operation shall be automatic based on PLC/microprocessor command.			
3.10.00	Back Pressure regulating valve			
3.10.01	Spring loaded disc operated self actuating type back pressure regulating valve to maintain 150 kg/cm ² (g) pressure on the compressor discharge.			
3.10.02	To be provided with accessories such as Pressure sensing element, controller etc.			
3.11.00	Cylinder Manifold			
3.11.01	To provide one dual cylinder filling manifold, arranged for two banks of minimum four cylinders each.			
3.11.02	To provide accessories such as Isolating valves, safety valves, Pressure gauges, pressure switch (To shut-off compressors beyond set pressure) "ON-LINE" Hydrogen purity analyser, trace oxygen analyser, moisture analyser at cylinder manifold, records of hydrogen purity and moisture content, & one number PORTABLE hydrogen gas purity testing kit.			

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
3.12.00	Flushing System			
3.12.01	To be provided with necessary connection with proper isolation devices, nitrogen cylinders, valves, manifolds piping etc to enable purging the system with nitrogen commissioning and each maintenance work.			
3.13.00	Piping			
3.13.01	All Pipe to conform to ASA pressure piping code, and seam less type.			
3.13.02	All high pressure joints shall of ferrule/ welded construction.			
3.13.03	All vents to be fitted with flame arrestor.			
3.13.04	All high pressure drains to be terminated through H2 traps and all low pressure drains to be terminated through U-bends.			
3.13.05	Cooling water pipe be minimum 80 NB size.			
4.00.00	VENTILATION SYSTEM			
4.01.00	It shall consist of adequate number of roof exhausters, wall mounted exhaust fans, ducting (if required), drives & other electrical accessories ducting supports and supporting system, rain protection cowl, bird screens, vibration isolators nuts & bolts, grouting frame, transition piece etc. as required to complete the system.			
4.02.00	The air quantity of ventilation system shall be estimated based on equipment and solar heat load and the temperature rise inside the building shall be restricted to maximum of 3 deg.C over design ambient. However, in no case the number of air changes shall be less than 30 air changes per hour. The exhaust air shall be discharged at a suitable height from the room.			
4.03.00	Bidder to provide louvers for fresh air supply the building layout.			
4.04.00	Bifurcated type of axial flow fans for exhausting air/fumes shall be provided for hydrogen generation plant area and shall be of flame proof construction with inlet and outlet dampers. However, ducts and all other parts like blades etc. shall be epoxy painted.			
5.00.00	HYDROGEN AND CO₂ GAS CYLINDERS			
5.01.00	Adequate quantity of gas cylinders shall be supplied and installed as described in relevant Electrical Sub-Sections of technical specification.			

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
6.00.00	CONTROL AND INSTRUMENTATION			
6.01.00	All electrical devices like switches/transmitters/controller/analyzer/solenoid valves which are located in the hydrogen generation plant shall be made intrinsically safe by providing suitable type of transformer isolated barrier/ Zenner barrier of standard make. Otherwise such instruments shall be provided with explosion proof enclosure suitable for hazardous areas described in National Electric Code (USA), Article 500, Class-I, Division-I or EN60079-14 or shall comply with the essential requirements of ATEX directives. All fittings, cable glands etc. shall be strictly as per NEC recommendation article, 500 to 503.			
7.00.00	PAINTING			
7.01.00	All the Piping, Valves and Equipments of this system shall be protected against external corrosion by providing suitable painting.			
7.02.00	The surfaces of stainless steel, Gunmetal, brass, bronze and non-metallic components shall not be applied with any painting.			
7.03.00	The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shotblasting etc as per the agreed procedure.			
7.04.00	For all the steel surfaces, one primer coat of epoxy resin based zinc phosphate primer of having a minimum DFT of 100 microns followed up with undercoat of epoxy resin based paint pigmented Titanium di-oxide with minimum DFT of 100 microns shall be applied. Thereafter topcoat shall be applied consisting of one coat of epoxy paint suitably pigmented of approved shade with glossy finish and DFT of 75 microns. Additionally finishing coat of polyurethane of minimum DFT 25 microns shall be provided over the topcoat. The paint may be applied in one coat, incase of high built paint is used, otherwise two coats shall be applied. Total DFT shall not be less than 300 microns.			
7.05.00	Painting of imported items shall however be as per manufacturer's standard practice.			



**TECHNICAL SPECIFICATION FOR
HYDROGEN GENERATION PLANT
2 X 800 MW NTPC GADERWARA STPP STAGE-I**

SPEC NO. PE-TS-394-168-A001

VOLUME-IIB

SECTION

REV.NO.0

DATE

SHEET

LOW PRESSURE PIPING SYSTEM

1.00.00	<u>LOW PRESSURE PIPING</u>			
1.01.00	EQUIPMENT SIZING CRITERIA			
1.02.00	All the piping systems and equipment supplied under this package shall be designed to operate without replacement and with normal maintenance for a plant service life of 30 years, and shall withstand the operating parameter fluctuations and cycling which can be normally expected during this period.			
1.03.00	For all L.P. piping system covered under this specification, sizing and system design shall be to the requirements of relevant codes and standard indicated elsewhere. In addition to this, requirements of any statutory code as applicable shall also be taken into consideration.			
	Inside diameters of piping shall be calculated for the flow requirements of various systems. The velocities for calculating the inside diameters shall be limited to the following:			
	a) Water Application			
		Water Velocity in m/sec		
	Pipe Size	Below 50 mm	50-150 mm	200 mm & above
	(a) Pump suction	-----	1.2-1.5	1.2-1.8
	(b) Pump discharge and recirculation	1.2-1.8	1.8-2.4	2.1-2.5
	(c) Header	-----	1.5-2.4	2.1-2.4
	Pipe line under gravity flow shall be restricted to a flow velocity of 1 m/sec generally. Channels under gravity flow shall be sized for a maximum flow velocity of 0.6 m/sec.			
	WILLIAM & HAZEN formula shall be used for calculating the friction loss in piping systems with the following "C" value:			
	(i) Carbon steel pipe	100		
	(ii) C.I Pipe/ Ductile Iron.	100		
	(iii) Rubber lined steel pipe	120		
	(iv) Stainless steel pipe	100		

	<p>For calculating the required pump head for pump selection, at least 10% margin shall be taken over the pipe friction losses and static head shall be calculated from the minimum water level of the tank/ sump/ reservoir from which the pumps draw water.</p> <p>(b) Compressed Air Application</p> <p>Compressed air 15.0 m/sec.(under Average Pressure & Temp. conditions)</p>
1.04.00	The pipes shall be sized for the worst (i.e. maximum flow, temp. and pressure values) operating conditions.
1.05.00	Based on the inside dia. so established, thickness calculation shall be made as per ANSI B 31.1 OD and thickness of pipes shall than be selected as per ANSI B 36.10/IS-1239 Heavy grade/IS-3589/ASTM-A-53/API-5L/ANSI B 36.19 as the case may be.
1.06.00	Corrosion allowance of 1.6 mm will be added to the calculated thickness being considered.
1.07.00	Bend thinning allowance/manufacturing allowance etc. shall be as per the requirement of the design code provision.
1.08.00	High points in piping system shall be provided with vents along with valves as per the system requirement. Low points shall be provided with drains along with drain valves as per the system requirement. Drain lines shall be adequately sized so as to clear condensate in the lines. Material for drain and vent lines shall be compatible with that of the parent pipe material.
1.09.00	Material of construction for pipes carrying various fluids shall be as specified elsewhere.
1.10.00	Compressed air pipe work shall be adequately drained to prevent internal moisture accumulation and moisture traps shall be provided at strategic locations in the piping systems.
1.11.00	Depending upon the size and system pressure, joints in compressed air pipe work shall be screwed or flanged. The flange shall be welded with the parent pipe at shop and shall be hot dip galvanized before dispatch to site. Alternatively, the flanges on GI pipes may be screwed-on flanges also.
1.12.00	Threaded joints shall be provided with Teflon sealant tapes.
1.13.00	Following types of valves shall be used for the system/service indicated.

	<table><tr><th rowspan="2">SYSTEM</th><th colspan="6">TYPES OF VALVES</th></tr><tr><th>Butterfly</th><th>Gate</th><th>Globe</th><th>Check</th><th>Ball</th><th>Plug</th></tr><tr><td>Water</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td></td></tr><tr><td>Air</td><td></td><td>x</td><td>x</td><td>x</td><td>x</td><td></td></tr><tr><td>Drains & vents</td><td></td><td>x</td><td>x</td><td>x</td><td></td><td></td></tr><tr><td>Fuel oil (if any)</td><td></td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td></tr></table>	SYSTEM	TYPES OF VALVES						Butterfly	Gate	Globe	Check	Ball	Plug	Water	x	x	x	x	x		Air		x	x	x	x		Drains & vents		x	x	x			Fuel oil (if any)		x	x	x	x	x
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1.14.00	Recirculation pipes along with valves, breakdown orifices etc. shall be provided for important pumping systems as indicated in respective process and instrumentation diagrams (p&ids). The recirculation pipe shall be sized for minimum 30%design flow of single pump operation or the recommended flow of the pump manufacturer whichever is higher.																																									
2.00.00	TECHNICAL SPECIFICATION																																									
2.01.00	GENERAL Specific technical requirements of low-pressure piping, fittings, supports, valves, specialties and tanks etc. have been covered under this Sub-section. It includes details pertaining to design and material of construction for piping, fittings, valves, equipment, etc. cleaning/surface preparation application of primer and painting on over ground piping. It also includes detailed technical requirement of laying underground/buried piping including water proofing/anti corrosive protection. It also covers design, engineering, manufacturing, fabrication, technical details of piping, valves, specialties, piping hangers / supports, tanks etc.																																									
2.02.00	Pipes and fittings																																									
2.02.01	All low pressure piping systems shall be capable of withstanding the maximum pressure in the corresponding lines at the relevant temperatures. However, the minimum thickness as specified in the following clauses and or respective codes for pipes and fittings shall be adhered to. The bidder shall furnish the pipe sizing/ thickness calculation as per the criteria mentioned above under LP piping equipment sizing criteria of this Technical Specification.																																									
2.02.02	Piping and fittings coming under the purview of IBR shall be designed satisfying the requirements of IBR as a minimum.																																									
2.02.03	Supporting arrangement of piping systems shall be properly designed for systems where hydraulic shocks and pressure surges may arise in the system during																																									

	operation. Bidder should provide necessary protective arrangement like anchor blocks/anchor bolt etc. for the safeguard of the piping systems under above mentioned conditions. The requirement will be, however, worked out by the contractor and he will submit the detailed drawings for thrust/anchor block to the Employer. External, and internal, attachments to piping shall be designed so as not to cause flattening of pipes and excessive localized bending stresses.
2.02.04	Bends, loops, off sets, expansion or flexible joints shall be used as required in order to prevent overstressing the piping system and to provide adequate flexibility. Flexibility analysis (using software packages such as Caesar-II etc.) shall be carried out for sufficiently long piping (straight run more than 300M).
2.02.05	Wherever Bidder's piping coming under this specification, terminates at an equipments or terminal point not included in this specification, the reaction and the thermal movement imposed by bidder's piping on equipment terminal point shall be within limits to be approved by the Employer.
2.02.06	The hot lines shall be supported with flexible connections to permit axial and lateral movements. Flexibility analysis shall be carried out for pipelines which have considerable straight run as indicated above and necessary loops/ expansion joint etc. shall be provided as may be necessary depending on layout.
2.02.07	Piping and fittings shall be manufactured by an approved manufacturer of repute. They should be truly cylindrical of clear internal diameter, of uniform thickness, smooth and strong, free from dents, cracks and holes and other defects.
2.02.08	For rubber lined ERW pipes, beads shall be removed.
2.02.09	Inspection holes shall be provided at suitable locations for pipes 800 Nb and above as required for periodic observations and inspection purposes.
2.02.10	At all intersection joints, it is Contractor's responsibility to design and provide suitable reinforcements as per the applicable codes and standards.
2.02.11	For large size pipes/ducts, at high point and bends/change of direction of flow, air release valves shall be provided as dictated by the system requirement and operation philosophy & tripping conditions of pumping system. Sizing criteria for air release valves shall be generally on the basis of valve size to pipe diameter ratio of 1:8. Requirement shall be decided as per relevant code. Transient analysis /surge analysis where ever specified and required shall be conducted in order to determine the location , number and size of the Air-Release valve on certain long distance/high volume piping systems, if applicable within the scope of work of the package.

2.03.00	Material															
2.03.01	Alternate materials offered by Bidder against those specified. shall either be equal to or superior to those specified, The responsibility for establishing equality or superiority of the alternate materials offered rests entirely with the Bidder and any standard code required for establishing the same shall be in English language.															
2.03.02	No extra credit would be given to offers containing materials superior to those specified. Likewise no extra credit would be given to offers containing pipe thickness more than specified.															
2.03.03	All materials shall be new and procured directly from the manufacturers. Materials procured from traders or stockists are not acceptable.															
2.03.04	All materials shall be certified by proper material test certificates. All material test certificates shall carry proper heat number or other acceptable references to enable identification of the certificate that certifies the material.															
2.03.05	Material of construction for pipes carrying various fluids shall be as follows: <table><tr><th>SI No.</th><th>Type of Fluid</th><th>Material</th></tr><tr><td>1.</td><td>i) Ordinary Water (Raw Water, Clarified Water, CW blow down water etc.) ii) Equipment cooling water including Both primary & secondary circuit (DMCW pH-corrected & ACW drain water)</td><td>IS-2062 Gr.-B/ASTM A-36/ASTM A-53 type 'E'Gr.B/IS-3589 Gr. 410 /IS-1239 Heavy.</td></tr><tr><td>2.</td><td>i) Demineralised water, ii) Alkaline solution (ECW system chemical dosing) iii) Equipment cooling water piping from overhead tank to suction header of DMCW pumps.</td><td>Stainless Steel to ASTM A312, Gr. 304 welded for sizes 65 mm NB and above. Stainless steel to ASTM A312, Gr. 304 sch.40s seamless for sizes 50mm and below</td></tr><tr><td>3.</td><td>i) Drinking (potable) water ii)Compressed air (Instrument & service air)</td><td>ASTM A-53 type E Gr. B galvanized/ IS 1239 Gr heavy galvanized/IS 3589 Gr 410 galvanized. Galvanized shall be to IS- 4736 or equivalent.</td></tr><tr><td>4.</td><td>(Condensate) spill water</td><td>ASTM A 106 Gr. B</td></tr></table>	SI No.	Type of Fluid	Material	1.	i) Ordinary Water (Raw Water, Clarified Water, CW blow down water etc.) ii) Equipment cooling water including Both primary & secondary circuit (DMCW pH-corrected & ACW drain water)	IS-2062 Gr.-B/ASTM A-36/ASTM A-53 type 'E'Gr.B/IS-3589 Gr. 410 /IS-1239 Heavy.	2.	i) Demineralised water, ii) Alkaline solution (ECW system chemical dosing) iii) Equipment cooling water piping from overhead tank to suction header of DMCW pumps.	Stainless Steel to ASTM A312, Gr. 304 welded for sizes 65 mm NB and above. Stainless steel to ASTM A312, Gr. 304 sch.40s seamless for sizes 50mm and below	3.	i) Drinking (potable) water ii)Compressed air (Instrument & service air)	ASTM A-53 type E Gr. B galvanized/ IS 1239 Gr heavy galvanized/IS 3589 Gr 410 galvanized. Galvanized shall be to IS- 4736 or equivalent.	4.	(Condensate) spill water	ASTM A 106 Gr. B
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4.	(Condensate) spill water	ASTM A 106 Gr. B														

2.03.06	In water lines, pipes upto 150mm Nb shall conform to ANSI B36.10/ASTM-A-53, Type-E Gr.B /IS:1239 Gr. Heavy and minimum selected thickness shall not be less than IS:1239 Grade Heavy except for demineralised water, drinking water and condensate spill lines.
2.03.07	Pipes of above 150mm Nb shall be to AWWA-C200/ANSI B 36.10/ASTM A-53/IS 3589 Gr.410. Pipe to be fabricated by the bidder shall be rolled and butt welded from plates conforming to ASTM A-53 type 'E' Gr. B/IS 2062 Gr.B/ASTM-A-36. However, larger pipes, i.e. 1000mm Nb and above shall be made from plates conforming to ASTM A 36/IS 2062 Gr.B and shall meet the requirements of AWWA-M-11 (for deflection & buckling criteria considering water filled pipe as well as vacuum condition that may prevail during transient/surge conditions, truck-load, rail-load and weight density for compacted soil or any other load as the case may be).
2.03.08	<p>In demineralised water service, the pipes upto 50 Nb shall be of stainless steel ASTM A 312, Gr. 304 sch. 40 Seamless. The size for these pipes shall be to ANSI B 36.19. These shall be socket welded. The material for pipe from 65mm NB upto and including 400 NB shall be to ASTM A 312, Gr. 304 (welded). In no case the thickness of fittings shall be less than parent pipe thickness.</p> <p>Bidder/Contractor shall note that pipes offered as per a particular code shall conform to that code in all respects i.e. Dimension, tolerances, manufacturing methods, material, heat treatment, testing requirements, etc. unless otherwise mentioned elsewhere in the specification.</p>
2.03.09	Instrument air, Plant (service) air lines and Drinking water lines shall be to ASTM A 53 type E grade B/ANSI B 36. 10/IS 3589, Gr. 410 / IS: 1239 Heavy (in case thickness calculated is more than gr. Heavy, ANSI B 36.10 Schedule numbers shall be followed) and galvanized to IS 4736 or any equivalent internationally reputed standard. The material of the pipes shall be to ASTM A 53 type 'E' Gr. B / IS: 3589, Gr. 410 / IS: 1239 Gr. Heavy. The fittings shall be of either same as parent material or malleable iron to IS-1879 (galvanized).
2.03.10	Spiral welded pipes as per API-5L/IS-3589 are also acceptable for pipe of size above 150 NB. However minimum thickness of the pipes shall be as elaborated in above clauses.
2.03.11	Condensate lines shall be to ASTM A 106 Gr. B and dimension to ANSI B 36.10 schedule "standard" as minimum to be maintained.
2.03.12	If carbon steel plates of thickness more than 12 mm are used for manufacture of pipes, fittings and other appurtenances, then the same shall be control-cooled or normalized as the case may be following the guidelines of the governing code.

2.04.00	Piping layout
2.04.01	Piping shall be grouped together where practicable and routed to present a neat appearance.
2.04.02	Piping routing shall be such as to provide sufficient clearance for removal and maintenance of equipment, easy access to valves, instruments and other accessories. The piping shall not encroach on the withdrawal space of various equipments.
2.04.03	Over head piping shall have a normal minimum vertical clearance of 2.5 meters above walkways and working areas and 8m above roadways/railways. When several pipe lines are laid parallel, flanged joints must be staggered. Welded and flanged joints should as far as possible be located at one third span from supports. if the support is situated right under the welded joints this joint must be reinforced with a strap. Flanged and welded joints must be avoided in the middle of the span. Valves should be located in such a manner so as to ensure their convenient operation from the floor or the nearest platform.
2.04.04	Pipe lines of NB 50 size and below are regarded as field run piping. It is Bidder's responsibility to plan suitable layouts for these system insitu. Bidder shall prepare drawings indicating the layout of field run pipe work. These drawings shall be approved by Project Manager to the installation of the field run pipe work. Based on these approved layouts the Bidder shall prepare the BOQ of field run-pipes and submit to Employer for approval.
2.04.05	All piping shall be routed so as to avoid interference with other pipes and their hangers and supports, electrical cable trays, ventilation ducting, structural members, equipment etc. Adequate clearance shall be ensured with respect to the above to accommodate insulation and pipe movements, if any.
2.04.06	Piping shall generally be routed above ground but where specifically indicated/approved by the Project Manager the pipes may be arranged in trenches or buried. Pipes at working temperature above the ambient shall however not be buried.
2.04.07	Sufficient up stream and down stream lengths shall be provided for flow measuring devices, control valves and other specialties.
2.04.08	All local instruments shall be located on pipe lines as to render them observable from the nearest available platforms.
2.04.09	Openings provided in the wall for pipelines must be closed with bricks and mortar with 10-12 mm clearance between brick work and pipe after taking care of insulation

2.05.00	and thermal movement, if any. The clear space must be filled with felt or asbestos or approved filling compound.
2.05.01	Slope/Drains and Vents
2.05.02	Suitable slope shall be provided for all pipelines towards drain points. It is Bidder responsibility to identify the requirements of drains and vents, and supply the necessary pipe work, valves, fittings, hangers and supports etc. As per the system requirement low points in the pipelines shall be provided with suitable draining arrangement and high points shall be provided with vent connections where air or gas pockets may occur. Vent for use during hydrostatic test shall be plugged after the completion of the test. Vent shall not be less than 15mm size. Drains shall be provided at low points and at pockets in piping such that complete drainage of all systems is possible. Drain shall not be less than 15mm for line size up to 150mm, not less than 20mm up to 300mm and not less than 25mm for 350mm to 600mm pipes and not less than 50mm for 600mm and above pipes.
2.06.00	Air piping shall be sloped so that any part of the system can be drained through the shut-off drain valve or drain plugs.
2.06.01	Pipe Joints
	In general all water lines 65mm NB and above, are to be joined generally by butt welding except the locations where valves/fittings are to be installed with flanged connections and 50mm and below by socket welding unless mentioned otherwise specifically. All air lines shall be of screwed connection and rubber lined pipes of flanged connections.
	Screwed
	<p>(a) Threading of pipes shall be carried out after bending, heat treatment etc. If not possible, threading may be done prior to these operations but proper care should be taken to protect them from damage. Threads shall be to ANSI B 2.1 (taper) NPT/IS: 554 unless specified otherwise.</p> <p>(b) Galvanized pipe shall generally be joined by screwing into sockets. The exposed threaded portion on the outside of the pipes shall be given a zinc silicate coating. Galvanized pipes shall not be joined by welding. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing. For galvanized pipe sizes above 150 mm NB, screw & socket jointing as per ASTM-A-865 shall be employed for both pipe-to-pipe and pipe-to-fitting jointing. For pipe to fitting connection since no direct threading can be done on the fittings (supplied as per ASTM-A-234 Gr. WPB and ANSI B-16.9) necessary straight pipe lengths acting as match pieces shall be welded to the fitting at both ends and subsequently the free</p>

2.06.02	<p>ends of the straight lengths shall be threaded as per ASTM A-865 for jointing with main pipe. Once welding of fittings with match pieces and threading of free ends of match pieces are over, the entire fabricated piece shall be galvanized, or in case match pipes and fittings are already galvanized before the above mentioned fabrication then suitable application of Zinc-Silicate paste adequately at the welded surface (both in side & out side) after welding with zinc rich electrode, along with the nascent threaded metal portions at both free ends given the same application of Zinc Silicate paste. Alternatively flanged jointing may be employed for pipe sizes 100 NB and above. However, the bidder shall ensure the galvanized pipe joints do not fail during hydro test.</p> <p>(c) Teflon tapes shall be used to seal out screwed joints and shall be applied to the male threads only. Threaded parts shall be wiped clean of oil or grease with appropriate solvent if necessary and allowing proper time for drying before applying the sealant. Pipe ends shall be reamed and all chips shall be removed. Screwed flanges shall be attached by screwing the pipe through the flange and the pipe and flange shall be refaced accurately.</p> <p>(d) For pipe sizes from 350 mm NB to 550 mm NB (including 350 NB & 550 NB) the GI pipes shall be of flanged connection. However, the pipes after welding of flanges shall be completely galvanized. Any site welding done on galvanized pipes shall be done with zinc-rich special electrodes and the welded surfaces whether inside or outside shall be coated with zinc-silicate paste. Seal welding of flanges with zinc-rich electrode will be permitted only when any flange is leak-prone during hydro testing.</p> <p>(e) For pipe sizes 600 mm NB and above, the GI pipes shall be of welded connection (with zinc-rich special electrodes) followed by application of zinc silicate coating at welded surfaces both inside and outside the pipe, except for the last blank/blind flange, or, equipment connection where application of zinc-silicate paste after welding cannot be done due to inaccessibility of the inside welded surface and where galvanic protection has been impaired due to welding of pipe-to-pipe joint. Thus the last erection joint shall be flanged joint.</p>
	<p>Welded</p> <p>(a) For making up welded joints (butt weld or socket weld) the welding shall be performed by manual shielded metal arc process in accordance with the requirements specified elsewhere in the spec. Any welder employed for carrying butt welding shall be qualified as per ASME section IX for the type of joints he is going to weld. Jointing by butt weld, or socket weld shall depend upon the respective piping material specifications.</p>

2.06.03	<p>Flanged</p> <p>(a) Flanged connections for pipes are to be kept to the minimum and used only for connections to vessel, equipments, flanged valves and other fittings like strainer/traps/orifices etc. for ease of connection and maintenance etc. Rubber lined pipes shall be flange joined only.</p> <p>(b) All flanged valves intended for installation on steel piping system, shall have their flanges drilled to ANSI B 16.5 (or equivalent) and according to the pressure class stated in their respective piping material specification.</p> <p>(c) Drilling on flanges of flanged valves must correspond to the drilling of flanges on the piping system on which the valves are installed.</p>
2.07.00	Bends/elbows/mitre bends/ Tees/ Reducers & other fittings
2.07.01	<p>For pipe fittings such as elbows (long radius), reducers, tees, etc. the material shall be to ASTM-A-234 Gr. WPB/ASTM-105 up to 300 NB. For pipe fittings above 300 NB, the fittings may be fabricated conforming to parent pipe material. Provision of compensation pads shall be kept as per ANSI B 31.1. The fitting shall conform to the dimensional standard of ANSI B-16.9/ 16.11. Further branching in pipes for sizes 65nb and above is also acceptable (ANSI B 31.1).</p> <p>However, for pipes up to 150 NB, pipe fittings may be supplied with material and dimension conforming to IS 1239 in case parent pipes also conform to IS 1239.</p>
2.07.02	<p>For pipe size 350Nb and above mitre bends may be used for all pipes except rubber lined pipes. The bend radius shall be 1½ times the nominal pipe diameter. 90 deg. bends (mitre) shall be in 4 pieces (3 cuts) and 45 deg. mitre bends shall be in 3 pieces 22½ deg. Fabrication of mitre bends shall be as detailed in BS 2633/BS534.</p>
2.07.03	<p>For pipes, above 1200 NB, reducer and tees shall be to dimensional standard of AWWA-C-208.</p>
2.07.04	<p>Stainless steel fittings shall conform to either ASTM-A-182 Gr. 304 or ASTM-A-403 Grade WP. 304 Class-S, for sizes upto and including 50 mm NB, i.e. the fittings shall be of seamless construction. However, for stainless fittings above 50 mm NB, the same shall conform to ASTM-A-403 Gr. WP 304 Class W i.e. the fittings shall be of welded construction strictly in accordance with ASTM-A-403.</p>
2.07.07	<p>In no case, the thickness of fittings shall be less than the thickness of parent pipe, irrespective of material of construction.</p>

2.08.00	Flanges
2.08.01	Flanges shall be slip on type. Welding of flanges in tension is not permitted.,
2.08.02	All flanges and-flanged drilling shall be to ANSI B 16.5/BS EN-1092 of relevant pressure/temperature class. Flanges shall be fabricated from steel plates conforming to ASTM A 105/IS 2062 Gr. B. However stainless steel flanges shall be fabricated from SS plates to ASTM-A-240, Gr. 304 (316 for Sea water application, if any) or equivalent.
2.09.00	Specific technical requirement of laying buried pipe with anti corrosive treatment
	The pipe in general shall be laid with the top of the pipe minimum 1.0 (one) meter below finished general ground level.
2.09.01	Trenching
	<p>(a) The trench shall be cut true to the line and level and shall follow the gradient of the pipeline. The width of the trench shall be sufficient to give free working space on each side of the pipe. Trenches shall conform to IS 5822.</p> <p>(b) Free access shall be provided for the welding of the circumferential joints by increasing the width and depth of the trench at these points. There should be no obstruction to the welder from any side so that good welded joint is obtained.</p> <p>(c) The free working space shall conform to IS: 5822. The trench shall be excavated so as to provide minimum cover of 1000mm between the top of the pipe and finished grade.</p> <p>(d) Prior to lowering and laying pipe in any trench, the bidder shall backfill and compact the bottom of the trench or excavation in accordance with is: 5822 to provide an acceptable bed for placing the pipe.</p> <p>(e) Coating and Wrapping shall be done as under</p>
2.09.02	Preparation and cleaning of piping
	<p>(a) The pipeline shall be thoroughly cleaned of all rust, grease, dirt, weld scales and weld burrs etc. moisture or other foreign matter by power cleaning method such as sand blasting, power tool cleaning, etc. Grease or heavy oil shall be removed by washing with a volatile solvent such as gasoline. Kerosene will not be permitted for cleaning. This cleaning operation shall be immediately followed by priming with the mechanical priming machine.</p>

2.09.03	<p>(b) Certain inaccessible portions of the pipeline (which otherwise not possible to be cleaned by power cleaning methods) may be scrubbed manually with a stiff wire brush and scrapped where necessary with specific permission of the Project Manager.</p> <p>(c) The cleaning and priming operation shall be carried out at site. The entire pipe length shall be cleaned but the ends of the pipes shall be left without coating for a distance of 230mm for joints, which shall be coated manually at site after laying, welding and testing the pipe.</p> <p>(d) On the internal surface for pipes 1000 Nb and above, a coat of primer followed by a hot coal-tar enamel or coal tar epoxy painting (cold) shall be applied.</p> <p>Coating and wrapping</p> <p>(a) Buried piping shall be coated and wrapped, as per specification, after completion of welded and/or flanged connections, and after completion and approval of Hydro testing. Materials to be used for coating and wrapping of underground pipelines are:</p> <p>(1) Coating primer (coal tar primer)</p> <p>(2) Coating enamel (coal tar enamel)</p> <p>(3) Wrapping materials.</p> <p>(b) All primer/coating/wrapping materials and methods of application shall conform to IS: 10221 except asphalt/bitumen material. Materials (primer/coating/wrapping) as per AWWA-C-203 are also acceptable.</p> <p>(c) Protective coating shall consist of coal tar primer, coal tar enamel coating, glass fiber, tissue inner wrap followed by glass fiber or coal tar impregnated Kraft outer wrap or finish coat</p> <p>(d) Number of coats and wraps, minimum thickness for each layer of application shall be as per IS-10221. Number of. Coats and wraps shall be decided based on soil corrosivity/resistivity as indicated in IS-10221. Soil data-for this purpose shall be made available.</p> <p>(e) Total thickness of completed coating shall not be less than 4.0 mm.</p> <p>(f) Alternatively, the anti-corrosive protection can consist of anti-corrosive protection Coal-tar tapes. Material and application of tapes shall conform to IS 15337 or equivalent. These-tapes shall be applied hot over the cold coal</p>

2.09.04	<p>tar primer preferably in steps of 2mm thickness so as to cover the spiral edges of the first tape by the application of second tape. The total thickness of the finished protective coating shall be 4.0 mm minimum.</p> <p>Trench bed preparation and back filling</p> <p>Prior to lowering and laying pipe in any excavated trench, the bottom of the trench may require to be back filled and compacted (or as the case may be) to provide an acceptable bed for placing the pipe. Bed preparation in general shall be as per IS: 5822.</p>
2.09.05	<p>Laying of galvanized steel (GI) pipes</p> <p>All the joints shall be screwed with socket or flanged. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing. Threaded portion on either side of the socket joint shall be applied with Zinc silicate paste.</p> <p>All the provisions for trenching' bed preparation' laying the pipe application of primer' coating' wrapping with tapes and back filling etc. as indicated for "laying of buried piping" and "anti corrosive protection for buried piping" are applicable for buried galvanized steel (GI) pipes also.</p>
2.10.00	Cleaning and flushing
2.10.01	All piping shall be cleaned by the Bidder before and after erection to remove grease, dirt, dust, scale and welding slag.
2.10.02	Before erection all pipe work, assemblies, sub-assemblies, fittings, and components, etc. shall be thoroughly cleaned internally and externally by blast cleaning or by power driven wire brushes and followed by air-blowing. The brushes shall be of the same or similar material as the metal being cleaned. Cleaning of Galvanized pipes shall be done in such a manner that the coating on MS pipe is not affected.
2.10.03	After erection, all water lines shall be mass flushed with water. The cleaning velocities in water lines shall be 1.2-1.5 times the operating velocities in the pipelines.
2.10.04	All compressed air pipe work shall be cleaned by blowing compressed air.
2.11.00	<p>Surface preparation and painting</p> <p>Pipes shall be cleaned both internally and externally thoroughly by blast-cleaning or power tool cleaning method as indicated above.. In case of oil piping, cleaning will have to be done by pickling. No painting is required on stainless steel pipe /</p>

2.11.01	<p>equipment surface, galvanized pipe surface or galvanized steel surface. However, necessary color banding for identification as per color code shall be done. External surface of piping shall be cleaned and prepared as indicated below.</p> <p>Primer painting</p> <p>(a) After the surface is prepared two coats of red oxide (zinc chromate/zinc phosphate) primer conforming to IS-2074/IS-12744 or equivalent shall be applied. Primer coat shall be immediately applied without any time lag after the surface preparation.</p> <p>(b) Any equipment which has been given the shop coat of primer shall be carefully examined after its erection in the field and shall be treated with a touch up coat of primer wherever the shop coat has been abraded, removed or damaged during transit/erection, or defaced during welding.</p>
2.11.02	<p>Finish painting</p> <p>(a) Paint to be used shall be synthetic enamel paint conforming to IS-2932 or equivalent. Finish painting shall be carried out in three coats consisting of one intermediate coat and two finishing coats. Dry film thickness (DFT) of painting inclusive of primer thickness shall be at least 150 micron.</p> <p>(b) The primed surface shall be cleaned of dust/dirt/grease etc. without scratching or in any way damaging the primer coat. The intermediate coat shall be allowed to dry before applying the finish coat or as recommended by paint manufacturer.</p> <p>(c) Paint shall be applied by brushing. It shall be ensured that brush marks are a minimum and the requirements of workmanship is as specified in IS-1477.</p> <p>(d) Paint used shall be stirred frequently to keep the pigment in suspension. Paint shall be of the ready mix type in original sealed containers as packed by the paint manufacturer. No thinners shall be permitted.</p> <p>(e) No painting shall be done in frost/foggy weather or when the humidity is high to cause-condensation on the surface to be painted.</p> <p>(f) The dry film thickness (DFT) after the painting shall not be less than 150 microns.</p>
2.11.03	<p>Other requirements</p> <p>(a) Paint manufacturers instructions shall be followed in method of application, handling, drying time etc.</p>

	<p>(b) The color of the finish paint shall be as per approved color-coding.</p> <p>(c) If finish paint was applied in shop, one coat of finish paint shall be applied at site.</p> <p>(d) The dry film thickness of paint shall not be less than 0.15 mm.</p>
2.11.04	<p>Color code for identification</p> <p>The pipes shall be color painted/banded for identification as per the approved color-coding scheme and shall be generally as per IS-9404.</p>
2.12.00	Specification for hangers and supports
2.12.01	All supports and parts shall conform to the requirement of power piping code ANSI B 31.1 or approved equivalent.
2.12.02	While designing supports for rubber lined pipes special consideration should be given. Any kind of welding on these pipes is not allowed after rubber lining.
2.12.03	Hanger for piping 65mm Nb and larger and all spring support assemblies regardless of size shall be completely engineered in conformance with the provisions of power piping code ANSI B 31.1.
2.12.04	Hangers, saddles, supports etc. shall be fabricated from plates/pipes sections conforming to ASTM A 53/IS: 2062/IS: 226/or equivalent. They shall be designed to provide the required supporting effects and allow pipe line movements as necessary. The structural steel work shall be as per IS: 800/BS: 4360. Insulation protection saddles shall be used at support point of all insulated piping.
2.12.05	The support shall be so interspaced as to minimize sagging of the pipes and to keep them within permissible limits where pipes are full with the conveying media.
2.12.06	The maximum spans of the supports of straight length shall not exceed the recommended values indicated in ANSI B 31.1.
2.12.07	All pipe supports shall be designed to provide an absolute minimum head room of 2.5 m from floor in passages/walkways.
2.12.08	At all sliding surfaces of supports suitable arrangement is to be provided to minimize sliding friction.
2.12.09	All components of hangers/supports shall be provided with two coats of primer (red oxide paint) at shop before dispatch to site. After erection they shall be given finish coat of Long Oil Synthetic enamel to IS: 2932 of total DFT 100 to 140 microns. CLH

2.13.00	<p>& VLH will be primed with Epoxy Zinc rich primer of 50 micron followed by finish painting of Aliphatic Acrylic Polyurethane or equivalent of DFT 65 microns.</p> <p>Design/Construction/Material Particulars of Gate/ Globe/Check Valves/ Globe Stop Valve/Butterfly valve</p>
2.13.01	<p>GENERAL</p> <ul style="list-style-type: none"> (a) All valves shall be suitable for the service conditions i.e flow, temperature and pressure, at which they are required to operate. (b) The valves as well as all accessories shall be designed for easy disassembly and maintenance. (c) Valves to be installed outside shall be required to have the stem properly protected against atmospheric corrosion. (d) All rising stem valves shall be provided with back seat to permit repacking (of glands) with valves in operation. All valves shall preferably be of outside screw and yoke type. (e) All valves shall be closed by rotating the hand wheel in the clockwise direction when looking at the face of the hand wheel. In case where the hand wheel is not directly attached to the valve spindle suitable gearing shall be introduced. (f) All valves shall have indicators or direction clearly marked on the hand-wheel so that the valves opening/closing can be readily determined. (g) Special attention shall be given to operating mechanism for large size valves with a view to obtaining quick and easy operation ensuring that a minimum of maintenance is required. For valves of size 350mm and above either bevel or spur gearing shall be provided to facilitate manual operation. (h) The valves coming in vacuum lines shall be of extended gland type and/or water sealed. (i) The actuator-operated valves shall be designed on the basis of the following: <ul style="list-style-type: none"> (1) The internal parts shall be suitable to support the pressure caused by the actuators; (2) The valve-actuator unit shall be suitably stiff so as not to cause vibrations, misalignments, etc.

	<p>(3) All actuator-operated valves shall be provided with hand operated gearing mechanism also.</p> <p>(4) All actuators operated valves shall open/ close fully within time required by the process.</p> <p>(j) Valves coming under the purview of IBR shall meet IBR requirements.</p> <p>(k) Gate/slucice valves shall be used for isolation of flow. Gate valves shall be provided with the following accessories in addition to other standard items:</p> <p>(1) Hand wheel</p> <p>(2) Position indicator (for above 50 mm NB valve size)</p> <p>(3) Draining arrangement wherever required.</p> <p>(l) Globe valves shall be used for regulation purposes. They shall be provided with hand wheel, position indicator, draining arrangement (wherever required) and arrow indicating flow direction.</p> <p>(m) Check valves shall be used for non-return service. They shall be swing. check type or double door (Dual plate)check type with a permanent arrow inscription on the valve body indicating the fluid flow direction. In long distance pipes lines with possibility of surge-occurrence, dual plate check valves are preferable for its spring controlled opening /closing of flaps/doors against flow reversals. However, dual plate check valves shall not be used for sizes more than 600mm NB</p> <p>(n) All gate and globe valves shall be provided with back seating arrangement to enable on line changing of gland packing.</p> <p>(o) All gate and globe valves shall be rising stem type and shall have limit switches for full OPEN and full CLOSED indication wherever required. This will include motor-operated valves also wherever required. In such cases the limit switches shall form an integral part of the valve. Stop-gap arrangement in this respect is not acceptable.</p> <p>(p) All valves shall be provided with embossed name plate giving details such as tag number, type, size etc.</p> <p>(q) Wherever required valves shall be provided with chain operator, extension spindles and floor stands or any other arrangement approved by employer so that they can be operated with ease from the nearest operating floor. Wherever necessary for safety purpose locking device shall be provided.</p>

2.13.02	<p>Further, necessary small platforms for facilitating easy valve operation shall be provided by the contractor wherever necessary in consultation with project manager within the bid price at no extra cost to employer.</p> <p>(r) All valves except those with rising stems shall be provided with continuous mechanical position indicators; rising stem valves shall have only visual indication through plastic/metallic stem cover for sizes above 50 mm nominal bore.</p> <p>(s) For CI gate, globe and check valves wherever thickness of body/bonnet is not mentioned in the valves standards, thickness mentioned in IS- 1538 for fitting shall be applicable.</p> <p>VALVE BODY MATERIAL</p> <p>Valve body material for various services shall be as follows:</p> <p>Valve body material for water application like circulating water, Secondary circuit auxiliary cooling water of ECW system, Raw water, Ash water make-up, service water, clarified water, DM cooling water (pH corrected) & drinking water shall be cast iron for sizes 65NB and above; gun-metal for sizes 50 Nb and below.</p> <p>For compressed air application, valve body material shall be cast carbon steel or forged carbon steel for sizes 65 mm NB & above and Gun metal for sizes 50 NB and below.</p> <p>DM water: SS body and disc along with SS internals.</p> <p>Condensate: Cast Carbon Steel / Forged Carbon Steel.</p> <p>2.13.03</p> <p>The design, material, construction, manufacture, inspection, testing and performance of valves shall comply with all currently applicable statutes, regulations and safety codes in the locality where the valves will be installed. The valves shall conform to the latest editions of applicable codes and standards as mentioned elsewhere. Nothing in this specification shall be construed to relieve the Bidder of his responsibility. Valves in general shall conform to the requirements of the following standards.</p> <p>Standards and Codes</p> <table border="0"> <tr> <td>AWWA-C-504</td><td>Rubber seated butterfly valves.</td></tr> <tr> <td>BS-5155/EN-593</td><td>Cast iron and steel body butterfly valves for general purpose.</td></tr> </table>	AWWA-C-504	Rubber seated butterfly valves.	BS-5155/EN-593	Cast iron and steel body butterfly valves for general purpose.
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2.13.04	IS-778	Gun-metal gate, globe and check valves for general purpose.
	BS-5154	Copper alloy globe/globe stop and check and gate valves for general purpose.
	IS-780	Sluice valves for water works purpose (50-300 mm size)
	IS-2906	Sluice valves for water works purpose (350-1200 mm size)
	IS-5150	Cast iron wedge and double disc gate for general purpose.
	BS-5152	Specification for cast iron globe valves.
	BS-5153	Cast iron check valves for general purpose.
	IS-5312	Swing check type reflux (non-return) valves.
	ANSI B 16.34	Standard for valves.
	API-594	Standard for Dual-check valves.
	API-600	Steel gate valves.
	ANSI-B-16.10	Valves face to face and other relevant dimension.
	API-598	Valves inspection test.
	End Connections	
	The end connections, shall comply with the following:	
	Socket welding (SW) - ANSI B 16.11	
	Butt Welding (BW) - ANSI B 16.25.	
	Threaded (SC) - ANSI B 2.1	
	Flanged (FL) - ANSI B 16.5& AWWA-C-207(steel flanges), ANSI B 16.1 (Cast Iron flanges)	

2.13.05	All cast iron body valves (gate, globe and non-return) shall have flanged end connections; (screwed ends for Ductile D.2NI body valves are not acceptable).
2.13.06	All steel and stainless steel body valves of sizes 65 mm and above shall have flanged or butt welding ends. Valves of sizes below 65mm shall have flanged or socket welded ends. Compatibility of welding between valve body material and connecting pipe material is a pre-requisite in case of butt-welded joints.
2.13.07	All gun metal body valves shall have screwed ends.
2.13.08	All flanged end valves/specialties. shall be furnished along with matching counter flanges, fasteners, gaskets etc. as required to complete the joints.
2.14.00	Check Valves
2.14.01	<p>Check valves shall comply with the following characteristics:</p> <ul style="list-style-type: none"> (a) For bore greater than 2" the valves must be swing check type or dual plate check type suitable for installation in all positions (vertical and horizontal); (b) For bore smaller than or equal to 2" the valves must be of the piston type to be installed, in horizontal position. (c) In the case of swing check valves, the body seat shall be inclined at such an angle from the vertical as will facilitate closing and prevent chatter.
2.14.02	Drilling on flanges of flanged valves must correspond to the drilling on flanges of the piping system on which the valves are to be installed.
2.14.03	All flanged valves intended for installation in steel piping systems shall have their flanges drilled to ANSI B 16.5 (or equivalent) and according to the pressure class.
2.14.04	Counter flanges to be installed on air pipes shall be screwed-on type irrespective of size.
2.15.00	Globe Valves
2.15.01	<p>The globe valves shall have the following characteristics:</p> <p>Straight conveyed flow.</p> <p>Right angle</p> <p>Preferably, the valves shall be of the vertical stem type.</p>

2.15.02	Globe valves shall preferably have radiused or spherical seating and discs shall be free to revolve on the spindle.
2.15.03	The pressure shall preferably be under the disc of the valve. However, globe valves, with pressure over the disc shall also be accepted provided (i) no possibility exists that flow from above the disc can remove either the disc from stem or component from disc (ii) manual globe valves can easily be operated by hand. If the fluid load on the top of the disc is higher than 40-60 KN, bypass valve shall be provided which permits the downstream system to be pressurized before the globe valve is opened.
2.15.04	For the regulating valves, valves with regulating plug & parabolic outline disc type is preferred.
2.15.05	All motorized globe valves with regulating plug for which indication of percentage (%) opening are required in the control room shall be provided with necessary position transmitter.
2.16.00	<p>Gate valves</p> <p>All gate valves shall be of the full-way type, and when in the full open position the bore of the valve shall not be constricted by any part of the gate.</p> <p>Gate valves shall be of the solid/elastic or articulated wedge disc and rising stem type.</p>
2.17.00	<p>Air Release Valve</p> <p>(a) The air release valves shall be of automatic double air valve with two orifices and two floats. The float shall not close the valve at higher air velocities. The orifice contact joint with the float shall be leak tight joint.</p> <p>(b) The valve shall efficiently discharge the displaced air automatically from ducts/pipes while filling them and admit air automatically into the ducts/pipes while they are being emptied. The valve shall also automatically release trapped air from ducts/pipes during operation at the normal working pressure.</p> <p>(c) Body material of automatic air release valves shall comply generally with BS 1452 Gr. 14/IS: 210 Gr. FG 260. and spindle shall conform to high tensile brass.</p> <p>(d) Air release valves shall not have any integral isolation device within them. Each Air release valve shall be mounted, preceded by a separate isolation gate/ butterfly valve.</p>

2.18.00	Butterfly valves
2.18.01	<p>Design/Construction</p> <p>(a) The valves shall be designed for the design pressure/temperature of the system on which it is installed and in accordance with AWWA-C-504, EN-593 or any other approved equivalent standard latest edition. Fabricated steel (IS: 2062 GR. B) butterfly valves instead of cast iron body valves are also acceptable for size above 300 mm nb diameter. In such a case, however, the bidder will have to necessarily submit thickness calculations, in order to establish the integrity of the fabricated valve body under the system operating pressure condition.</p> <p>(1) The valves shall be suitable for installation in any position (horizontal/vertical etc.) and shall be generally of double-flanged construction. However for sizes 600 NB and below the valves of Wafer construction are also acceptable</p> <p>(2) The seals, both on the body (sleeve) and on the disc shall be of the material specified. Necessary shaft seal shall be provided and adequately designed to ensure no leakage across the seal. This seal shall be designed so that they will allow replacement without removal of the valve shaft. The sealing ring on the disk shall be continuous type and easily replaceable.</p> <p>(3) For all types of valves, the design with shaft eccentric to the disc is preferred. The shaft shall be solid type and shall pivot on bushings. Bushings/sleeve type bearings shall be contained in the hub of valve body. The bearing shall be self-lubricated type with low coefficient of friction and should not have any harmful effect on water and on valve components.</p> <p>(4) The design of the shaft shall be such that it will safely sustain maximum differential pressure across the closed valve. The shaft and any key (taper pin etc.) for transmitting the torque between shaft and disc shall be capable of withstanding the maximum torque required to operate the valve. However, the shaft diameter shall not be less than the minimum shaft diameter specified in relevant code. Necessary Torque Calculation and the torque class selected on the basis of the same shall be furnished to the Employer for information.</p> <p>(5) The disc shall rotate from the full open to the tight shut position. The disc shall be contoured to ensure the least possible resistance to flow and shall be suitable for throttling operation. While the disc is in the throttled position, valve shall not create any noise or vibration.</p>

	<p>(6) The operating mechanism shall be mounted directly on or supported from the valve body.</p> <p>(7) All valves shall be complete with:</p> <p>Position indicator (located in a visible place)</p> <p>Arrow indicating the flow direction;</p> <p>Adjustable mechanical stop limiting devices to prevent over</p> <p>Travel of valve disc in open/close position.</p> <p>All valves shall be "tight shut off"</p> <p>(8) Hand operated valves shall have the following</p> <p>Local hand controls</p> <p>The hand controls shall close the valve with clockwise rotation.</p> <p>The hand controls shall be dimensioned to guarantee an easy maneuver under most severe conditions.</p> <p>The hand controls shall be provided with locking systems suitable to avoid the disc assuming a non-desirable position during the operation.</p> <p>Hand wheel shall be made of malleable iron with arms and rims of adequate strength. The hand wheel of diameters 300mm or less shall be provided with handles for ease of operation.</p> <p>Valves-350Nb and above shall have pressure equalizing bypass valves, wherever system parameters warrant the same.</p> <p>Valves-200Nb and above shall also be provided with gear operator arrangement as a standard practice suitable for manual operation. Manual operation of valve shall be through gear arrangement having totally enclosed gearing with hand wheel diameter and gear ratio designed to meet the required operating torque It shall be designed to hold the valve disc in intermediate position between full open and full closed position without creeping or fluttering. Adjustable stops shall be provided to prevent over travel in either direction.</p>

2.18.02	<p>Limit and torque switches (if applicable) shall be enclosed in water tight enclosures along with suitable space heaters for motor actuated valves, which may be either for On-Off operation or inching operation with position transmitter.</p> <p>Material of Construction (Butterfly Valves)</p> <p>Materials and other design details shall be as indicated below :</p> <p>(a) Cast Iron Butterfly Valves</p> <table> <tr> <td>Body & Disc</td><td>ASTM A48, Gr. 40 with 2% Ni/ IS: 210. Gr. FG-260, with 2% Ni and epoxy coated</td></tr> <tr> <td>Shaft</td><td>BS 970 431 S: 291 / EN 57, or AISI-410 or AWWA-permitted shaft material equivalent to EN-57/AISI-410 or better.</td></tr> <tr> <td>Seat ring</td><td>18-8 Stainless steel</td></tr> <tr> <td>Seal</td><td>Nitrile Rubber</td></tr> </table> <p>(b) Stainless Steel Butterfly Valves</p> <table> <tr> <td>Body & Disc</td><td>ASTM A 351, Gr. CF8M / ASTM-A-182-Gr.304.</td></tr> <tr> <td>Shaft</td><td>ASTM A 182, Gr. 316 / ASTM-A-479 Gr.316/Equivalent</td></tr> <tr> <td>Disc & Seat Rings</td><td>EPT/BUNA-N/Neoprene</td></tr> </table> <p>(c) Carbon steel Butterfly Valves</p> <table> <tr> <td>Body & Disc</td><td>ASTM A 216, Gr. WCB</td></tr> <tr> <td>Shaft</td><td>ASTM A 182, Gr. 304 / ASTM-A-479 Gr.304/Equivalent</td></tr> <tr> <td>Disc & Seat Rings</td><td>EPT/BUNA-N/Neoprene</td></tr> </table>	Body & Disc	ASTM A48, Gr. 40 with 2% Ni/ IS: 210. Gr. FG-260, with 2% Ni and epoxy coated	Shaft	BS 970 431 S: 291 / EN 57, or AISI-410 or AWWA-permitted shaft material equivalent to EN-57/AISI-410 or better.	Seat ring	18-8 Stainless steel	Seal	Nitrile Rubber	Body & Disc	ASTM A 351, Gr. CF8M / ASTM-A-182-Gr.304.	Shaft	ASTM A 182, Gr. 316 / ASTM-A-479 Gr.316/Equivalent	Disc & Seat Rings	EPT/BUNA-N/Neoprene	Body & Disc	ASTM A 216, Gr. WCB	Shaft	ASTM A 182, Gr. 304 / ASTM-A-479 Gr.304/Equivalent	Disc & Seat Rings	EPT/BUNA-N/Neoprene
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2.18.03	<p>Proof of Design Test (Type Test) for Butterfly Valves</p> <p>Proof of Design (P.O.D.) test certificates shall be furnished by the bidder for all applicable size-ranges and classes of Butterfly valves supplied by him, in the</p>																				

2.19.00	<p>absence of which actual P.O.D. test shall be conducted by the bidder in the presence of Employer's representative.</p> <p>All valves that are designed and manufactured as per AWWA-C-504 shall be governed by the relevant clauses of P.O.D test in AWWA-C-504. For Butterfly valves designed and manufactured to EN-593 or equivalent, the P.O.D. test methods and procedures shall generally follow the guidelines of AWWA-C-504 in all respect except that Body & seat hydro test and disc-strength test shall be conducted at the pressures specified in EN-593 or the applicable code. Actuators shall also meet requirements of P.O.D. test of AWWA-C-504.</p> <p>MATERIAL OF CONSTRUCTION (GATE/GLOBE/CHECK VALVE)</p> <p>(a) The materials shall generally comply with the following:</p> <p>(1) Cast Steel Valves</p> <table border="0"> <tr> <td>Body & bonnet</td><td>ASTM A 216 Gr. WCB/ ASTM A 105</td></tr> <tr> <td>Disc for non-return Valves</td><td>ASTM A 216 Gr. WCB/ ASTM A 105</td></tr> <tr> <td>Trim.</td><td>ASTM A 182 Gr. F6 or Equivalent</td></tr> </table> <p>(2) Stainless steel valves</p> <table border="0"> <tr> <td>Body & Bonnet</td><td>ASTM A 351 Gr. CF 8M/ ASTM A 182 Gr. 304</td></tr> <tr> <td>Disc</td><td>-do-</td></tr> <tr> <td>Trim.</td><td>ASTM 182 Gr. F. 316 /ASTM-A-479Gr.316 / ASTM A 351 Gr. CF 8M</td></tr> </table> <p>(3) Cast iron valves</p> <table border="0"> <tr> <td>Body & bonnet</td><td>BS 1452 Gr. 14/ IS-210 Gr. FG 260</td></tr> <tr> <td>Seating surfaces and rings</td><td>13% chromium steel/ 13% Chrome overlay</td></tr> <tr> <td>Disc for non-return valves</td><td>BS 1452 Gr. 14/IS-210 Gr FG 260</td></tr> <tr> <td>Hinge pin for non-return valves</td><td>AISI 316</td></tr> </table>	Body & bonnet	ASTM A 216 Gr. WCB/ ASTM A 105	Disc for non-return Valves	ASTM A 216 Gr. WCB/ ASTM A 105	Trim.	ASTM A 182 Gr. F6 or Equivalent	Body & Bonnet	ASTM A 351 Gr. CF 8M/ ASTM A 182 Gr. 304	Disc	-do-	Trim.	ASTM 182 Gr. F. 316 /ASTM-A-479Gr.316 / ASTM A 351 Gr. CF 8M	Body & bonnet	BS 1452 Gr. 14/ IS-210 Gr. FG 260	Seating surfaces and rings	13% chromium steel/ 13% Chrome overlay	Disc for non-return valves	BS 1452 Gr. 14/IS-210 Gr FG 260	Hinge pin for non-return valves	AISI 316
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Seating surfaces and rings	13% chromium steel/ 13% Chrome overlay																				
Disc for non-return valves	BS 1452 Gr. 14/IS-210 Gr FG 260																				
Hinge pin for non-return valves	AISI 316																				

2.20.00	<p>Stem for gate globe valves 13% chromium steel or Equivalent</p> <p>Back seat 13 % chromium steel / 13% Chrome overlay</p> <p>(4) Gun Metal valves</p> <p>Body and bonnet IS 318 Gr. 2/ Equivalent Standard</p> <p>Trim. -do-</p> <p>(b) Cast iron body valves shall have high alloy steel stem and seat.</p> <p>(c) Material for counter flanges shall be the same as for the piping.</p> <p>Float operated valves</p> <p>(a) Valve shall automatically control the rate of filling and will shut off when a predetermined level is reached and close to prevent over flow on pre-set maximum water level. Valve shall also open and close in direct proportion to rise or fall of water level.</p> <p>(b) DESIGN AND CONSTRUCTION FEATURES</p> <p> The following design and construction feature of the valve shall be the minimum acceptable.</p> <p>(c) Valves shall be right-angled or globe pattern.</p> <p>(d) Valves shall be balance piston type with float ball.</p> <p>(e) Leather liner shall not be provided.</p> <p>(f) The body and cover material shall be cast iron conforming to ASTM-A 126 Grade 'B' or IS: 210 Grade 200 or equivalent, and Float shall be of copper with epoxy painting of two (2) coats.</p> <p>(g) Valves shall be suitable for flow velocities of 2 to 2.5m/sec.</p> <p>(h) The valves shall have flanged connections.</p>
	2.21.00 PAINTING OF VALVES:
	Two (2) coats of primer followed by three (3) coats of enamel of approved color

	code/shade (usually same as that of connected piping) shall be applied to all exposed surfaces except stainless steel surface, Galvanized steel surface and gun metal surface at shop as required to prevent corrosion, before dispatch. The use of grease/oil other than light grade mineral oil, for corrosion protection is prohibited. The total DFT of painting shall be 150 micron (minimum). If during transport, unloading/unpacking or erection at site any part of the painted surface gets damaged, the same shall be made good by the contractor by repainting with compatible painting primer and enamel to the satisfaction of the project manager.
2.22.00	Tanks and Accessories
2.22.01	The designer and manufacturer of storage tanks shall comply with and obtain approval of all currently applicable statutory regulations and safety codes in the locality where the equipment will be installed. The tanks shall conform to IS 803/IS804/IS 805/ IS 2825/ API 650/ IS 4049/ IS 4682 (part-I) and IS 4864 to 4870/ ASME B & PV code Sec.-VIII as the case may be.
2.22.02	DESIGN AND CONSTRUCTION <ul style="list-style-type: none"> (a) Design of all vertical atmospheric storage tanks containing water, acid, alkali and other chemical shall conform to IS:803 & API 650. (b) Design of all horizontal atmospheric storage tanks containing water, acid, alkali and other chemicals shall generally conform to IS:2825 as regards to fabrication and general construction taking care of combined bending, shear & hoop stresses developed due to supporting arrangement. (c) Design temperature of vessels shall be 10 deg.C higher than the maximum temperature that any part of the vessel is likely to attain during the course of operation. (d) Tank shall be made from mild steel plates to BS 4360/IS-2062 Gr.B (or equivalent). (e) The joint efficiency factors to be adopted for design calculations shall be in accordance with the specified design code. (f) Tank shall be provided with suitable supporting joints. All vessels shall be provided with lifting lugs, eye bolts etc. for effective handling during erection. (g) The material for flanges shall be of ASTM A 105/ IS-2062 Gr.B. (h) For cylindrical tanks, the plates shall be cold rolled through plate bending machine by several number of passes to true curvature.

2.22.03	<p>(i) Vessel seams shall be so positioned that they do not pass through vessel connections. For cylindrical vessel consisting of more than two sections longitudinal seams shall be offset.</p> <p>(j) Tanks shall be provided with float operated level indicators/level gauges/level transmitters and level switches, as required, with complete assembly. Suitable flanged pads for level switches mounting shall also be provided. The level indicator can be top or side mounted as the case may be.</p> <p>(k) In addition to inlet and outlet nozzles, the tanks shall be provided with vents, overflow, drain nozzles complete for various connections on tanks. Overflow lines from storage tanks is to be routed to the nearest surface drains. For tanks containing dm water, alkaline water or power cycle water the vent to atmosphere shall be through carbon-di-oxide absorber vessel suitably mounted on the tank. CO2 absorber vessel shall be provided with the initial fill of chemicals. Similarly for equipment cooling water overhead tank, the overflow & drain from tank shall be combined together and shall be led to nearest drain (at zero level) via. a seal-trough so as not to come directly in contact with atmosphere.</p> <p>(l) Tanks shall have suitable stairs/ladders on inside and outside of the tanks, manholes/inspection covers as required and also platform suitably located.</p> <p>(m) Tank supporting arrangement as approved by Employer shall be provided with all plates/angles/joints/flats and supporting attachment including lugs, saddles, legs etc.</p> <p>(n) Piercing nozzles/pipes from tank body / dish ends shall be adequately compensated as per relevant code.</p> <p>(o) Tank fabrication drg. and design calculations shall be approved by the Project Manager.</p> <p>Corrosion protection</p> <p>(a) A corrosion allowance, applicable to surface in contact with corrosive media, when required, shall be taken into consideration.</p> <p>(b) Manholes shall be provided for easy access into the vessels. The size shall be minimum 500 mm and will be with cover plate, nuts bolts, etc. to ensure leak tightness at the test pressure.</p> <p>(c) Each tank shall be provided with drilled cleats welded to the tank for electrical grounding. Material of cleats shall be same as that of the shell.</p>

.2.22.04	<p>(d) Epoxy-coating shall be provided on the inside of vessel in three coats (minimum) resulting in total thickness of not less than 200 micron in which ever case required, such as equipment cooling water overhead tank, sodium hydroxide tank, condensate surge tank etc.</p> <p>Cleaning & Painting</p> <p>(a) Inside surface of all tanks shall be protected by anti-corrosive paints as required.</p> <p>(b) For tanks/vessel requiring epoxy painting, all inside surface shall be blast cleaned using non-siliceous abrasive after usual wire brushing.</p> <p>(c) Outside surfaces of all vessels shall be provided with two coats of primer with three (3) coats of epoxy minimum 100mm DFT resin based paint of approved color.</p>
2.23.00	RUBBER EXPANSION JOINTS
2.23.01	All parts of expansion joints shall be suitably designed for all stresses that may occur during continuous operation and for any additional stresses that may occur during installation and also during transient condition.
2.23.02	The expansion joints shall be single bellow rubber expansion joints. The arches of the expansion joints shall be filled with soft rubber.
2.23.03	The tube (i.e. inner cover) and the cover (outer) shall be made of natural or synthetic rubber of adequate hardness. The shore hardness shall not be less than 60 deg. A for outer and 50 deg. A for inner cover.
2.23.04	The carcass between the tube and the cover shall be made of high quality cotton duck, preferably, square woven to provide equal strength in both directions of the weave. The fabric plies shall be impregnated with age resistant rubber or synthetic compound and laminated into a unit.
2.23.05	Reinforcement, consisting of solid metal rings embedded in carcass shall be provided.
2.23.06	Expansion joints shall be complete with stretcher bolt assembly. The expansion joints shall be suitable to absorb piping movements and accommodate mismatch between pipe lines.
2.23.07	The expansion joints shall be of heavy duty construction made of high grade abrasion-resistant natural or synthetic rubber compound. The basic fabric for the'

2.23.08	<p>duck' shall be either a superior quality braided cotton or synthetic fibre having maximum flexibility and non-set characteristic.</p> <p>The expansion joints shall be adequately reinforced, with solid steel rings, to meet the service conditions under which they are to operate.</p>
2.23.09	<p>All expansion joints shall be provided with stainless steel retaining rings for DM water application and IS 2062 Gr B galvanized steel retaining rings for ordinary water for use on the inner face of the rubber flanges, to prevent any possibility of damage to the rubber when the bolts are tightened. These rings shall be split and beveled type for easy installation and replacement and shall be drilled to match the drilling on the end rubber flanges and shall be in two or more pieces.</p>
2.23.10	<p>The expansion joints shall have integral fabric reinforced full-face rubber flanges. The bolt on one flange shall have no eccentricity in relation to the corresponding bolt hole on the flange on the other face. The end rubber flanges shall be drilled to suit the companion pipe flanges.</p>
2.23.11	<p>All exposed surfaces of the expansion joint shall be given a 3 mm thick coating of neoprene. This surface shall be reasonably uniform and free from any blisters, porosity and other surface defects.</p>
2.23.12	<p>Each control unit shall consist of two (2) numbers of triangular stretcher bolt plates, a stretcher bolt with washers, nuts, and lock nuts. Each plate shall be drilled with three holes, two for fixing the plate on to the companion steel flange and the third for fixing the stretcher bolt.</p>
2.23.13	<p>Each joint shall have a permanently attached brass or stainless steel metal tag indicating the tag numbers and other salient design features.</p>
2.23.14	<p>Bidder to note that any metallic part which comes in contact with DM /corrosive water shall be of Stainless Steel material.</p>
2.24.00	<p>STRAINERS</p>
2.24.01	<p>Simplex type</p> <p>The strainers shall be basket type and of simplex construction. The strainer shall be provided with plugged drain/blow off and vent connections. The free area of the strainer element shall be at least four (4) times the internal area of the connecting pipe lines. The strainer element shall be 20 mesh. Pressure drop across the strainers in new condition shall not exceed 1.5 MCW at full flow. Wire mesh of the strainers shall be suitably reinforced, to avoid buckling under operation. Strainer shall have screwed blow off connection fitted with a removable plug. The material of construction of various parts shall be as follows:</p>

2.24.02	(a)	Body	IS: 318, Gr. 2 up to 50 mm Nb, and IS: 210 Gr. FG 260 above 50 mm Nb. (For DM water/ -Body: AISI 316 or equivalent)
	(b)	Strainer Element	Stainless steel (AISI 316)
	(c)	End connection	Screwed upto 50 mm Nb, and Flanged above 50 mm Nb
	Duplex type		
	(a)	The strainers shall be basket type and of duplex construction. The strainer shall be provided with plugged drain/blow off and vent connections. The free area of the strainer element shall be at least four (4) times the internal area of the connecting pipe. The mesh of strainer element shall be commensurate with the actual service required. Pressure drop across the strainer in new condition shall not exceed 4.0 MWC at full flow.	
	(b)	Wire mesh (if applicable) of the strainers shall be suitably reinforced. The material of construction of various parts shall be as follows.	
		Body	IS: 318, Gr. 2 up to 50 mm Nb, and IS:210, Gr. FG 260 or ASTM-A-515 Gr. 75/IS-2062 Gr. B and internally epoxy-painted above 50 mm NB.
		Strainer element	Stainless steel (AISI 316)
		End connection	Screwed up to 50mm Nb, and Flanged above 50 mm Nb. Gasket shall be of full face type
	(c)	The strainer will have a permanent stainless steel tag fixed on the strainer body indicating the strainer tag number and service and other salient data.	
(d)	The size of the strainer and the flow direction will be indicated on the strainer body casting.		
(e)	Thickness of the strainer element should be designed to withstand the pressure developed within the strainer due to 100% clogged condition exerting shut-off pressure on the element.		

2.24.03	Three shop coats of paint preceded by two coats of primer shall be applied to all exposed surfaces as required to prevent corrosion.. All parts shall be adequately protected for rust prevention. The use of grease or oil other than light grade mineral oils for corrosion protection is prohibited.



**TECHNICAL SPECIFICATION FOR
HYDROGEN GENERATION PLANT
2 X 800 MW NTPC GADERWARA STPP STAGE-I**

SPEC NO. PE-TS-394-168-A001

VOLUME-IIB


SECTION


REV.NO.0


DATE


SHEET

**FUNCTIONAL GUARANTEES AND LIQUIDATED
DAMAGES**

CLAUSE NO.	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES			
	<p style="text-align: center;">FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES</p> <p style="text-align: center;">FOR</p> <p style="text-align: center;">SHORTFALL IN PERFORMANCE AND GUARANTEE TESTS</p> <p>(The term "Performance Guarantees" wherever appears in this Sub-Section shall have the same meaning and shall be synonymous to "Functional Guarantees". Similarly the term "Performance Tests" wherever appears in this Sub-Section shall have the same meaning and shall be synonymous to "Guarantee Test(s)".</p>			
1.00.00	PERFORMANCE GUARANTEES			
1.00.01	<p>General Requirements</p> <p>(a) The Contractor shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in these specifications.</p> <p>(b) The guaranteed performance parameters furnished by the Bidder in his offer, shall be without any tolerance values and all margins required for instrument inaccuracies and other uncertainties shall be deemed to have been included in the guaranteed figures.</p> <p>(c) The Contractor shall demonstrate all the guarantees covered herein during functional guarantee / acceptance test. The various tests which are to be carried out during performance guarantee/acceptance test are listed in this Sub-section. The guarantee tests shall be conducted by the Contractor at site in presence of Employer on each unit individually.</p> <p>(d) All costs associated with the tests shall be included in the bid price.</p> <p>(e) In case during performance guarantee test(s) it is found that the equipment/system has failed to meet the guarantees, the Contractor shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements at no extra cost to the Employer and re-conduct the performance guarantee test(s) with Employer's consent. However if the specified performance guarantee(s) are still not met but are achieved within the Acceptable Shortfall Limit specified at clause 1.01.02 of this sub-section, Employer will accept the equipment/system/plant after levying liquidated damages as per clause</p>			


CLAUSE NO.	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES			
	<p>1.01.02 of this sub-section. If, however, the demonstrated guarantee(s) continue to be more than the stipulated Acceptable Shortfall Limit, even after the above modifications/replacements within ninety (90) days or a reasonable period allowed by the Employer, after the tests have been completed, the Employer will have the right to either of the following :</p> <p>(i) For Category-I Guarantees</p> <p>Reject the equipment / system / plant and recover from the Contractor the payments already made</p> <p style="text-align: center;">OR</p> <p>Accept the equipment /system/ plant after levying Liquidated Damages as specified hereunder. The liquidated damages for shortfall in performance indicated in clause 1.01.02 of this sub-section shall be levied separately for each unit. The rates indicated in clause 1.01.02 of this sub-section are on per unit basis. The liquidated damages shall be pro-rated for the fractional parts of the deficiencies. The performance guarantees coming under this category shall be called 'Category-I' Guarantees.</p> <p>(ii) For Category-II Guarantees</p> <p>Reject the equipment / system/ plant and recover from the Contractor the payments already made. The performance guarantees under this category shall be called 'Category-II' Guarantees. Conformance to the performance requirements under Category-II is mandatory.</p> <p>(iii) For Category-III Guarantees</p> <p>Reject the equipment /system / plant and recover from the Contractor the payments already made.</p> <p style="text-align: center;">OR</p> <p>Accept the equipment/system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by the Employer. Such damages shall, however be limited to the cost of replacement of the equipment(s) / system(s), replacement of which shall remove the deficiency so as to achieve the guaranteed performance. These parameters/capacities shall be termed as Category-III Guarantees.</p>			


CLAUSE NO.	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES			
1.01.00	Guarantees under Category-I			
1.01.01	<p>The performance guarantees which attract liquidated damages are as follows:</p> <ul style="list-style-type: none">(i) Turbine Cycle Heat rate in kcal/kWhr under rated steam conditions at 77 mm Hg (abs) condenser pressure with zero make up at 840 MW unit load (i.e. 105% of rated load).(ii) Turbine Cycle Heat rate in kcal/kWhr under rated steam conditions at 77 mm Hg (abs) condenser pressure with zero make up at 800 MW unit load (i.e. 100% of rated load).(iii) Continuous TG output of 840MW unit load (i.e. 105% of rated load) under rated steam conditions at 77 mm Hg (abs) condenser pressure with 0% make-up.(iv) Condenser pressure in mm Hg (abs) measured at 300 mm above the top row of condenser tubes under VWO conditions, 3% make up, design CW temperature and CW flow. <p>Note: The condenser pressure measurement while conducting the guarantee tests from (i) to (iv) above shall be measured at 300 mm above the top row of condenser tubes.</p> <ul style="list-style-type: none">(v) CW pumping power in KW for design CW flow and the pressure drop on CW side being measured between Bidder's terminal points. (Power consumption shall be computed based on overall efficiency of 83% of CW pump and drive set).(vi) Auxiliary Power Consumption <p>Auxiliary Power Consumption at 100% TMCR (800 MW) Unit Load.</p> <p>The total auxiliary power consumption for all the Turbine Generator auxiliaries and turbine cycle equipments and other common auxiliaries required for continuous unit operation at 800 MW (i.e 100% rate load) under rated steam conditions and at condenser pressure of 77 mm Hg (abs) with 0% make-up shall be guaranteed in line with the requirements stipulated in Clause 1.01.03 of this Sub-Section.</p> <p>Note: Power consumption of each of the pump/fan/compressors etc. wherever mentioned shall be measured with its own drive.</p>			


CLAUSE NO.	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES				
1.01.02	AMOUNT OF LIQUIDATED DAMAGES APPLICABLE FOR CATEGORY-I GUARANTEES				
	If the performance guarantee(s) specified at clause 1.01.01 are not met by the Contractor even after the modifications and/or replacements mentioned at clause 1.00.01 (e) of this Sub-section but are achieved within the stipulated Acceptable Shortfall Limit as indicated in this clause, Employer will accept the equipment/system/plant after levying liquidated damages as indicated here under, however, if the demonstrated guarantee(s) continue to be more than the stipulated Acceptable Shortfall Limit, the Employer may at his discretion reject the equipment/system and recover the payment already made or accept the equipment/system only after levying liquidated damages against the Contractor, at the rates listed herein, and such liquidated damages shall be deducted from the Contract Price:				
	Sl. No.	Guarantee		Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
	i)	For increase in the guaranteed turbine cycle heat rate			
		a)	At 105% TMCR (840MW) Unit Load	US \$ 179,029 (US dollar One hundred seventy nine thousand and twenty nine only) per 1 Kcal/Kwhr increase in heat rate.	(+) 2.5 % of the guaranteed turbine cycle heat rate.
		b)	At 100% TMCR (800MW) Unit Load	US \$ 682,015 (US dollar Six hundred eighty two thousand and fifteen only) per 1 Kcal/Kwhr increase in heat rate.	(+) 2.5 % of the guaranteed turbine cycle heat rate subject to maximum of 1850 Kcal/Kwhr.
	ii)	For deficiency in Turbine Generator output		US \$ 651 (US dollar Six hundred fifty one only) per 1 KW short fall in TG output	(-) 2% of guaranteed Turbine Generator output
	iii)	For deficiency in condenser pressure		US \$ 987,618 (US dollar Nine hundred eighty seven thousand and six hundred eighteen only) per 1 mmHg increase in condenser pressure	(+) 2.5% of the guaranteed condenser pressure
	iv)	For increase in C.W. pumping power for pressure		US \$ 2,845 (US dollar Two thousand and eight hundred forty five only) per	(+) 1% of the guaranteed C.W. pumping power


CLAUSE NO.	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES			<div>एन टी पी सी NTPC</div>
		drop and C.W. flow in condenser (Power consumption shall be computed based on overall efficiency of 83% for the CW pump and drive set)	1 KW increase in CW pumping power.	
	v)	Auxiliary Power Consumption		
		Auxiliary Power Consumption at 100% TMCR (800 MW) unit load for increase in the auxiliary power consumption in KW guaranteed as per the requirements of Cl.1.01.01(vi) of this Sub Section.	US \$ 2,845 (US dollar Two thousand and eight hundred forty five only) per 1 KW increase in Aux. Power consumption	(+) 1% of the guaranteed auxiliary power consumption
	<p>NOTE :</p> <p>i) Each of the liquidated damages specified above shall be independent and these liquidated damages shall be levied concurrently as applicable.</p> <p>ii) If the contract currency is other than US dollars, then the liquidated damages shall be in equivalent amount in contract currency based on Bill selling exchange rate of State Bank of India prevailing on the date of award of contract.</p> <p>iii) All these liquidated damages for short fall in performance shall be deducted from the contract price as detailed in accompanying General Conditions of Contract (GCC)/ Special Conditions of Contract (SCC)</p> <p>iv) Contractor's aggregate liability to pay liquidated damages for failure to attain the functional guarantee shall not exceed twenty five percent (25%) of the Contract Price.</p>			





CLAUSE NO.	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES			
1.01.03	<p>Auxiliary Power Consumption</p> <p>The unit auxiliary power consumption shall be calculated using the following relationship.</p> $P_a = P_u + T_L$ <p>P_a = Guaranteed Auxiliary Power Consumption.</p> <p>P_u = Power consumed by the auxiliaries of the unit under test.</p> <p>T_L = Losses of the transformers supplied by bidder based on works test reports.</p> <p>While guaranteeing the auxiliary power consumption the bidder shall necessarily include all continuously operating unit auxiliaries. The auxiliaries to be considered shall include but not be limited to the following :</p> <p>UNIT AUXILIARIES (to be considered for calculating P_u)</p> <ul style="list-style-type: none"> (a) Turbine Unit Oil purifier. (b) Turbine Unit control oil purifier. (c) Electric oil heater for turbine lube oil. (d) Feed and discharge pumps of turbine oil purification system. (e) Main turbine Condenser air evacuation pumps. (f) BFP drive turbine Condenser air evacuation pumps (if envisaged). (g) Main turbine Condenser tube cleaning system pumps. (h) BFP drive turbine Condenser tube cleaning system pumps (if envisaged). (i) Condensate extraction pumps. (j) Drip pump (if envisaged). (k) BFP drive turbine Condensate extraction pumps (if envisaged). (l) Oil purifiers of 2x50% TDBFPs and their feed and discharge pumps. (m) Lube oil pumps of 2x50% TDBFPs and the electrical oil heater for lube oil. 			


CLAUSE NO.	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES			
1.01.04	<p>(n) Auxiliary oil pump for MDBFP.</p> <p>(o) Oil pumps for HP-LP bypass system.</p> <p>(p) Motor Driven Boiler Feed Pump</p> <p>(For this purpose only 15% of the deemed power consumed by both the MDBFPs at 100% TMCR unit load shall be considered).</p> <p>(q) DM Cooling (normally working) Water pumps to supply cooling water on the secondary (DM) side of the plate type heat exchangers in the closed loop Equipment cooling (Unit auxiliaries) water system.</p> <p>(r) Auxiliary Cooling (normally working) water pumps to supply cooling water on the secondary side of the plate type heat exchangers in the closed loop Equipment cooling (unit auxiliary) water system.</p> <p>(s) One third (33%) of power consumption of one stream of hydrogen generation plant.</p> <p>(t) Power consumption of any other continuously operating auxiliaries for unit operation at different guarantee point loads.</p> <p>Note :</p> <ol style="list-style-type: none"> The bidder shall furnish a list of equipments to be covered under auxilliary power consumption, which shall be subject to Employer's approval. Power consumption at rated duty point sl. no- (s) and (t) to be arrived at based on shop test. Power consumption for hydrogen generation plant at its rated capacity shall be arrived at based on site test. 			
	<p>HEAT RATE</p> <p>Turbine Cycle Heat Rate shall be calculated as follows & indicated in all computed heat balance diagrams :</p> $\text{HEAT RATE} = \frac{M1 (H1-h1) + M2 (H3-H2) + Mis (h1-his)+ Mir (H3 - hir)}{Pg}$ <p>The expression "Mis (h1-his)" in the numerator of the formula is not applicable if spray water to superheater is completely internal to the boiler (i.e. tapped from a location downstream of economizer inlet).</p>			


CLAUSE NO.	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES			
	<p>Where,</p> <p>M1 - Quantity of live steam entering the turbine stop valve including any live steam supplied to valve stems, or glands etc. in Kg/hr.</p> <p>M2 - Quantity of steam from turbine to reheater in Kg/hr.</p> <p>Mir - Quantity of desuperheating water flowing into reheater system for regulation of steam temperature in Kg/hr.</p> <p>Mis - Superheater desuperheating spray flow in Kg/hr.</p> <p>H1 - Enthalpy in kcal/kg of live steam.</p> <p>H2 - Enthalpy in kcal/kg of steam to reheat.</p> <p>H3 - Enthalpy in kcal/kg of reheated steam.</p> <p>h1 - Enthalpy of feed water in kcal/kg at the downstream of the junction of feed flow and bypass flow of HP heaters.</p> <p>hir - Enthalpy of desuperheating water flowing into reheat system in Kcal/Kg.</p> <p>his - Enthalpy of superheater desuperheating spray water in Kcal/Kg.</p> <p>Pg - Unit output after deducting the power consumption by auxiliaries as listed below and the same shall be 840MW, and 800MW respectively for 105%, and 100% TMCR unit load:</p> <p>(a) Power taken by Excitation system (KW) including transformer losses, as applicable for various guarantee points, in case of static excitation system is offered. (The transformer losses at various points shall be based on factory test to be conducted).</p> <p>(b) Power required for ventilation of oil and control fluid tanks, if ventilating fans are separately driven (KW).</p> <p>(c) Power required for lubrication, if lubricating pumps are separately driven (KW).</p> <p>(d) Power required for control fluid pumps, if control fluid pumps are separately driven (KW).</p> <p>(e) Power required for hydrogen, seal oil auxiliaries, if separately driven (KW).</p>			


CLAUSE NO.	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES			
	<p>(f) Power required for stator water cooling system, if cooling pumps are driven separately (KW).</p> <p>It may be noted that the heat balance diagrams and guarantees shall be furnished considering zero spray water quantity for superheater and reheater spray. During Performance Guarantee Testing, in case water is required for superheater and/or reheater temperature control, the contractor shall be entitled to heat rate correction as per correction curves to be submitted by him with his offer.</p>			


CLAUSE NO.	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES			
1.02.00	<p>GUARANTEES UNDER CATEGORY - II</p> <p>NIL</p>			

CLAUSE NO.	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES			
	GUARANTEES UNDER CATEGORY - III			
1.03.00	The parameters/capabilities to be demonstrated for various systems/equipments shall include but not be limited to the following:			
1.03.01	Noise All the plant, equipment and systems covered under this specification shall perform continuously without exceeding the noise level over the entire range of output and operating frequency specified in General Technical Requirement, Part-C Section-VI of the technical specifications. Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirement of IEC 651 or BS 5969 or IS 9779. Sound pressure shall be measured all around the equipment at a distance of 1.0 m horizontally from the nearest surface of any equipment/ machine and at a height of 1.5 m above the floor level in elevation. A minimum of 6 points around each equipment shall be covered for measurement. Additional measurement points shall be considered based on the applicable standards and the size of the equipment. The measurement shall be done with slow response on the A - weighting scale. The average of A-weighted sound pressure level measurements expressed in decibels to a reference of 0.0002 micro bar shall not exceed the guaranteed value. Corrections for background noise shall be considered in line with the applicable standards. All the necessary data for determining these corrections, in line with the applicable standards, shall be collected during the tests.			
1.03.02	Condenser On Load Tube Cleaning System Life of sponge rubber balls and number of balls lost during 1000 hours of plant operation shall be as indicated by Bidder in the offer and accepted by the Employer.			
1.03.03	Deaerator Dissolved O2 content in Deaerator effluent at deaerator outlet without chemical dosing at all loads, not to exceed 0.005 CC/litre determined as per ASTM-D-888 – Reference method-A or Indigo Carmine method.			

CLAUSE NO.	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES			
1.03.04	Turbine hall and other EOT Crane : Over load test, travel & hoist speed checks etc., shall be demonstrated as per IS: 3177 (latest edition).			
1.03.05	Equipment Cooling Water System Design heat load of plate type heat exchangers and Inlet & Outlet temperatures of the Plate type heat exchangers on the primary and secondary side to be demonstrated at site. Pressure drop across the Plate type heat exchanger on the primary & secondary water circuit to be demonstrated at site.			
1.03.06	Condensate Polishing Unit i) Effluent quality at outlet of each vessel at its rated design flow and design service length between two regenerations. ii) Pressure drop across the polisher service vessel (as defined elsewhere) in clean and dirty condition of resin at rated design flow.			
1.03.07	Hydrogen Generation Plant i) Capacity & discharge pressure of hydrogen gas compressors at its rated duty point with its job (own) motor shall be demonstrated and proved at shop. ii) Parallel operation of two streams shall be demonstrated at site. Purity level and moisture content of Hydrogen shall be demonstrated at site. iii) Hydrogen generation plant capacity (stream wise) shall be demonstrated at site.			
1.03.08	EOT, HOT Cranes & Monorail Hoist : Over load tests, travel and hoist speed checks as per relevant Indian standard IS (latest edition).			
1.03.09	Passenger Lifts for TG Building & Service Building : Over load tests, travel and hoist speed checks.			
1.03.10	Electrical System As applicable and/or as specified in the technical specification in electrical Sub-section.			

CLAUSE NO.	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES			
2.00.00	PERFORMANCE GUARANTEE / ACCEPTANCE TEST			
2.01.00	General Requirements			
2.01.01	It is the responsibility of the Contractor to perform the Performance Guarantee/Acceptance test as specified in this Sub-Section. The performance tests will be performed using only the normal number of Employer supplied operating staff. Contractor, vendor or other subcontractor personnel shall only be used for instructional purposes or data collection. At all times during the Performance Tests the emissions and effluents from the Plant shall not exceed the Guaranteed Emission and Effluent Limits.			
2.01.02	The Contractor shall make their system ready for the performance guarantee tests.			
2.01.03	<p>All instruments required for performance testing shall be of the type and accuracy required by the code and prior to the test, the contractor shall get these instruments calibrated in an independent test Institute approved by the Employer. All test instrumentation required for performance tests shall be supplied by the contractor and shall be retained by him upon satisfactory completion of all such tests at site. All costs associated with the supply, calibration, installation and removal of the test instrumentation shall be included in the bid price. All calibration procedures and standards shall be subjected to the approval of the Employer. The protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes.</p> <p>Tools and tackles, thermowells (both screwed and welded) instruments/devices including flow devices, matching flanges, impulse piping & valves etc. and any special equipment, required for the successful completion of the tests, shall be provided by the contractor free of cost.</p>			
2.01.04	<p>The contractor shall submit for Employer's approval the detailed Performance Test procedure containing the following :</p> <p>(a) Object of the test.</p> <p>(b) Various guaranteed parameters & tests as per contract.</p> <p>(c) Method of conductance of test and test code.</p> <p>(d) Duration of test, frequency of readings & number of test runs.</p> <p>(e) Method of calculation.</p> <p>(f) Correction curves.</p> <p>(g) Instrument list consisting of range, accuracy, least count, and location of instruments.</p>			

CLAUSE NO.	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES			
	<p>(h) Scheme showing measurement points.</p> <p>(i) Sample calculation.</p> <p>(j) Acceptance criteria.</p> <p>(k) Any other information required for conducting the test.</p> <p>The Performance / Acceptance test shall be carried out as per the agreed procedure. The PG test procedure including demonstration tests shall be submitted within 90 days of the date of Notification of Award and finalization of the PG test procedure shall be done within 180 days from the date of Notification of Award. After the conductance of Performance test, the contractor shall submit the test evaluation report of Performance test results to Employer promptly but not later than one month from the date of conductance of Performance test. In case post test calibration takes longer time then modalities for submission of PG test report by the bidder shall be mutually agreed upon during the test. However, test data shall be submitted to the Employer after completing each test run.</p>			
2.01.05	<p>Test Interruptions</p> <p>In the event of a test interruption resulting from an Event of Force Majeure or Employer-Caused-Delay, Contractor shall be entitled to relief as provided in the contract, provided that, the interrupted Performance Test must be started again and test data that were collected during the interrupted test must be ignored.</p>			
2.02.00	<p>Turbine Generator Performance/ Acceptance Test</p>			
2.02.01	<p>Performance test for the turbine generator set will be conducted in accordance with the latest edition of ASME PTC-6. Such test shall be binding on the parties to the contract to determine compliance with the guaranteed heat balance conditions at 840 MW (105% TMCR) MW and 800 MW (100% TMCR) unit outputs corresponding to the conditions stipulated under Cl. 1.22.01 of Sub-section- A-3 (Turbine Generator and Auxiliaries), Part-B. Power consumed by the auxiliaries mentioned under clause 1.01.03 of this Sub-section which is to be deducted from electrical power generated, shall be measured during the performance / Acceptance Test. Wherever the measurement is not possible, design values of power consumption by an auxiliary shall be considered.</p>			
2.02.02	<p>The essential mandatory requirements for instruments, methods and precautions to be employed shall be in accordance with the requirements specified in the respective codes. All the necessary instruments (in duplicate) required for the tests shall be furnished by the contractor so as to meet the accuracies specified in the codes. Any advanced class instrument system such as those using electronic devices or mass flow technique shall be arranged by the contractor, if required. For determination of primary flow to the turbine, a calibrated low Beta-ratio throat-tap</p>			

CLAUSE NO.	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES			
2.02.03	<p>nozzle assembly including required machined straight lengths meeting the requirement of ASME PTC-6 shall be provided. The test procedures, Calibration Standards, Calibration procedures etc., shall be subject to Employer's approval. All the instruments including the flow nozzle shall be calibrated by the contractor before and after the test, in a reputed international institute as approved by the Employer. However, post test calibration of flow nozzle shall not be mandatory. During the test if it is found that the parameters are in order as regards to calibrations of instruments and after post test calibration of instruments, the difference between pre test and post test calibrations is within code acceptable limits, bidder shall submit the report of PG test results based on pre test effects (calibration) of instruments. These calibrations shall be performed in the presence of the Employer. All calibrations shall be made available prior to the test and calibration certificates in original submitted to Employer at least 15 days before conductance of the test for Employer's approval. The instruments shall be sealed after calibration by calibrating lab. The percentage calibration error/deviation should not be more than accuracy class of the instrument. Calibration low beta ratio throat tap nozzle assembly including flow straightner, upstream and down stream machined straight lengths, for main condensate flow measurements shall be as per ASME PTC6.</p> <p>Secondary flow devices shall be calibrated flow nozzle / orifice plate as per ASME-PTC 19.5.</p> <p>Corrections to the test results for steam turbine shall be applied as per the correction curves listed in detailed technical specification Part-B. When the system is properly isolated for a performance test, the unaccounted for leakages should not be more than 0.1% of the design throttle flow at that load. To achieve the above value of unaccounted for leakages, the Bidder shall prepare the unit during pretest available shutdown. However, during the test, if it is found that the unaccounted for leakage is more than 0.1% of design throttle flow at that load, then heat rate will be increased by an amount equal to half the difference between actual unaccounted for leakage expressed as percentage of design throttle flow at that load and 0.1% (allowed by the code). If the unaccounted leakage during the test shall be more than 0.3 % of design throttle flow at that load and appreciable leakage is visible in Boiler area, mutual agreement shall be made regarding consideration of excess leakage in the calculation of test results.</p>			
2.02.04	<p>The performance guarantee test will be carried out after successful completion of initial operation. Ageing allowance will be given during evaluation of PG test results and hence guaranteed heat rates shall be increased by the amount calculated as per the formula given in Cl. No. 3.07, Sub-Section-3 of ASME-PTC-6 Report 1985 (Reaffirmed 1991). Period of ageing shall be considered from the date of first synchronization to the date of conductance of PG test.</p> <p>In calculating the above factor any period(s) during which the turbine has not been in operation at a stretch for more than a week shall not be considered</p>			

CLAUSE NO.	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	<div>एनटीपीसी NTPC</div>		
2.02.05	The tests shall be arranged in a manner that the EMPLOYER's operation is not disrupted. Duplicate test runs shall be performed at 840 MW and 800 MW unit loads. The results of corrected heat rate shall agree within 0.25%. If they differ by more than 0.25%, third test shall be run at the same point. The corrected result of any one of the three test runs, which deviates from the corrected averaged result of all the runs by more than 0.25%, shall be eliminated; otherwise the results of all the three tests runs shall be accepted.			
2.02.06	During Performance/ Acceptance test, following tests shall be carried out for T.G. set with test grade instruments as per ASME code. <div><div>(i)</div>Guarantee Turbine Cycle Heat rate test at 840MW (105% rated load) corresponding to the heat balance diagram specified in Sub-Section-A-3, Part-B, Section-VI.</div> <div><div>(ii)</div>Guarantee Turbine Cycle Heat rate test at 800MW corresponding to the heat balance diagram specified in Sub-Section-A-3, Part-B, Section-VI.</div> <div><div>(iii)</div>Guarantee Output test of 840 MW (105% rated load) corresponding to the heat balance diagram specified in Sub-Section-A-3, Part-B, Section-VI.</div> <div><div>(iv)</div>CW pumping power in KW for design CW flow and the pressure drop on CW side being measured between Bidder's terminal points. (Power consumption shall be computed based on overall efficiency of 83% of CW pump and drive set).</div>			
2.02.07	Performance test for the condensers will be conducted in accordance with the latest edition of ASME PTC-12.2 with the exception at (a) mentioned below : <div><div>(a)</div>Condenser pressure will be measured at 300 mm above the top row of tubes under VWO conditions, 3% make-up and design C.W. flow & design temperature. The condenser pressure shall be measured with a vacuum grid utilising ASME basket tips. The grid is fitted at 300 mm above top row of condenser tubes.</div> <div><div>(b)</div>Combined pressure drop in condenser tube, waterbox, and inlet and outlet piping will be measured in between intake and discharge point of the C.W. system at BIDDER'S terminal points with cleanliness factor of 0.9 and COLTCS in service.</div>			
2.03.00	Test Reports <p>The Contractor shall prepare test reports for the Availability Test, Efficiency Test, Capacity Test and the Emissions test, in which the methods followed, instrument readings, graphs, observations, final results obtained, etc., shall be recorded.</p>			



**TECHNICAL SPECIFICATION FOR
HYDROGEN GENERATION PLANT
2 X 800 MW NTPC GADERWARA STPP STAGE-I**

SPEC NO. PE-TS-394-168-A001

VOLUME-IIB

SECTION

REV.NO.0

DATE

SHEET

**TECHNICAL SPECIFICATION FOR EMPTY HYDROGEN
NITROGEN CYLINDERS**



TECHNICAL SPECIFICATION FOR HYDROGEN GENERATION PLANT 2 X 800 MW NTPC GADERWARA STPP STAGE-I

SPEC NO. PE-TS-394-168-A001

VOLUME-IIB

SECTION

REV.NO.0

DATE

SHEET

EMPTY HYDROGEN / NITROGEN CYLINDER (46.7 liters water capacity)

1.0 SCOPE

This specification covers the design, manufactures, testing and supply of empty seamless hydrogen cylinders as per the requirements specified herein.

2.0 STANDARD APPLICABLE

Latest edition of IS: 3224 and IS: 7285

3.0 DIMENSIONS

- a. Outside diameter 232 mm
- b. Cylinder wall thickness 5.4 mm (min)
- c. Overall length 1445 mm

4.0 DESIGN

The top end should be necked down to 2" diameter and screw internally to diameter 1" standard taper 1 in 8, 14 TPI to IS: 3224. The bottom of cylinder shall be concave.

5.0 FITTINGS

The gas cylinders should be complete with the following fittings/ accessories.

- a. Neck collar
- b. Protection cap
- c. Outlet valve to IS:3224
- d. Safety valve/Bursting disc.

6.0 CAPACITY

- a. Water capacity 46.7 liters
- b. Volume gas 7m³(app.)

7.0 WORKING PRESSURE 150kg/cm²

8.0 MATERIAL

The cylinders shall conform to IS: 7285 and shall be made of seamless solid drawn high carbon manganese steel. The valve body shall be made of brass and internals of stainless steel.

9.0 REQUIREMENT OF CYLINDERS

As per IS: 7285

10.0 PAINTING & MARKING ON CYLINDERS

To be as per IS: 7285

11.0 INFORMATION REQUIRED WITH THE OFFER

Cylinder drawing indicating the following details:



TECHNICAL SPECIFICATION FOR HYDROGEN GENERATION PLANT 2 X 800 MW NTPC GADERWARA STPP STAGE-I

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- a) The standard to which cylinders and fittings confirm.
- b) Capacity, size and wall thickness of cylinder.
- c) Details and arrangement of fittings.
- d) Minimum wall thickness of cylinder.
- e) Working pressure, pneumatic test pressure, hydraulic test pressure and hydraulic stretch test pressure.

12.0 TEST CERTIFICATES

- a) Test certificates for all the tests indicated in clause 9.0 of this specification.
- b) Manufacturer shall furnish inspection certificate from BIS and approval certificate from department of explosive Nagpur.

13.0 GENERAL

- a) The offer submitted shall be strictly in line with the requirements specified in this specification.
- b) All the documents as required in clause 12 shall be submitted in 5 copies.



**TECHNICAL SPECIFICATION FOR
HYDROGEN GENERATION PLANT
2 X 800 MW NTPC GADERWARA STPP STAGE-I**

SPEC NO.PE-TS-394-168-A001

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SECTION – D2

**DESIGN REQUIREMENTS
ELECTRICAL**

Note: Some of the design requirement specified in section D2 may not be relevant to the bidder design. Only the requirements relevant for bidder's system shall be considered by the bidder.



**TECHNICAL SPECIFICATION FOR
HYDROGEN GENERATION PLANT
2 X 800 MW NTPC GADERWARA STPP STAGE-I**

SPEC NO. PE-TS-394-168-A001

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SHEET

MOTORS

1.10.00	<p>Degree of Protection</p> <p>Degree of protection for various enclosures as per IS:4691, IEC60034-05 shall be as follows :-</p> <table><tr><td>i)</td><td>Indoor motors</td><td>-</td><td>IP 54</td></tr><tr><td>ii)</td><td>Outdoor motors</td><td>-</td><td>IP 55</td></tr><tr><td>iii)</td><td>Cable box-indoor area</td><td>-</td><td>IP 54</td></tr><tr><td>iv)</td><td>Cable box-Outdoor area</td><td>-</td><td>IP 55</td></tr></table>	i)	Indoor motors	-	IP 54	ii)	Outdoor motors	-	IP 55	iii)	Cable box-indoor area	-	IP 54	iv)	Cable box-Outdoor area	-	IP 55				
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2.00.00	<p>CODES AND STANDARDS</p> <table><tr><td>1)</td><td>Three phase induction motors</td><td>:</td><td>IS:325, IEC:60034</td></tr><tr><td>2)</td><td>Single phase AC motors</td><td>:</td><td>IS:996, IEC:60034</td></tr><tr><td>3)</td><td>Crane duty motors</td><td>:</td><td>IS:3177, IEC:60034</td></tr><tr><td>4)</td><td>DC motors/generators</td><td>:</td><td>IS:4722</td></tr><tr><td>5)</td><td>Energy Efficient motors</td><td>:</td><td>IS 12615, IEC:60034-30</td></tr></table>	1)	Three phase induction motors	:	IS:325, IEC:60034	2)	Single phase AC motors	:	IS:996, IEC:60034	3)	Crane duty motors	:	IS:3177, IEC:60034	4)	DC motors/generators	:	IS:4722	5)	Energy Efficient motors	:	IS 12615, IEC:60034-30
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3.00.00	<p>TYPE</p>																				
3.01.00	<p>AC Motors:</p> <table><tr><td>a)</td><td colspan="3">Squirrel cage induction motor suitable for direct-on-line starting.</td></tr><tr><td>b)</td><td colspan="3">Continuous duty LT motors upto 160 KW Output rating (at 50 deg.C ambient temperature), shall be Energy Efficient motors, Efficiency class-Eff 1, conforming to IS 12615, or High efficiency (IE2) as per IEC:60034-30.</td></tr><tr><td>c)</td><td colspan="3">Crane duty motors shall be slip ring/ squirrel cage Induction motor as per the requirement.</td></tr></table>	a)	Squirrel cage induction motor suitable for direct-on-line starting.			b)	Continuous duty LT motors upto 160 KW Output rating (at 50 deg.C ambient temperature), shall be Energy Efficient motors, Efficiency class-Eff 1, conforming to IS 12615, or High efficiency (IE2) as per IEC:60034-30.			c)	Crane duty motors shall be slip ring/ squirrel cage Induction motor as per the requirement.										
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3.02.00	<table><tr><td>DC Motors</td><td>Shunt wound.</td></tr></table>	DC Motors	Shunt wound.																		
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4.00.00	<p>RATING</p> <table><tr><td>(a)</td><td colspan="3">Continuously rated (S1). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor.</td></tr><tr><td>(b)</td><td colspan="3">Whenever the basis for motor ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven</td></tr></table>	(a)	Continuously rated (S1). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor.			(b)	Whenever the basis for motor ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven														
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(b)	Whenever the basis for motor ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven																				

	<p>equipment under entire operating range including voltage and frequency variations.</p> <p>(c) For BFP motors starting MVA shall be restricted to 80 MVA.</p>
5.00.00	<p>TEMPERATURE RISE</p> <p>Air cooled motors</p> <p>70 deg. C by resistance method for both thermal class 130(B) & 155(F) insulation.</p> <p>Water cooled</p> <p>80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method for both thermal class 130(B) & 155(F) insulation.</p>
6.00.00	OPERATIONAL REQUIREMENTS
6.01.00	Starting Time
6.01.01	For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.
6.01.02	For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time.
6.01.03	For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.
6.01.04	Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.
6.02.00	Torque Requirements
6.02.01	Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.
6.02.02	Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.
6.03.00	<p>Starting voltage requirement</p> <p>(a) 85% below 110 KW</p> <p>(b) 80% from 110 KW to 200 KW</p>

	<p>(c) 85% above 200 KW to 1000 KW</p> <p>(d) 80% from 1001 KW to 4000 KW</p> <p>(e) 75% above 4000KW</p> <p>Except AOP & JOP motors running on D.G emergency supply, starting voltage shall be 80%.</p>
7.00.00	DESIGN AND CONSTRUCTIONAL FEATURES
7.01.00	Suitable single phase space heaters shall be provided on motors rated 30KW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided. However for flame proof motors , space heater terminals inside the main terminal box may be acceptable.
7.02.00	<p>All motors shall be either Totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). CW motors can be screen protected drip proof (SPDP) type. Motors and EPB located in hazardous areas shall have flame proof enclosures conforming to IS:2148 as detailed below</p> <p>(a) Fuel oil area : Group – IIB</p> <p>(b) Hydrogen generation :Group - IIC (or Group-I, Div-II as per plant area NEC) or (Class-1, Group-B, Div-II as per NEMA /IEC60034)</p>
7.03.00	<p>Winding and Insulation</p> <p>(a) Type : Non-hygroscopic, oil resistant, flame resistant</p> <p>(b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature.</p> <p>(c) 11kV & 3.3 kV AC motors : Thermal class 155 (F) insulation. The winding insulation process shall be total Vacuum Pressure Impregnated i.e resin poor method. The lightning Impulse & interturn insulation surge withstand level shall be as per IEC-60034 part-15</p> <p>(d) 240VAC, 415V AC & 220V DC motors : Thermal Class(B) or better</p>
7.04.00	Motors rated above 1000KW shall have insulated bearings to prevent flow of shaft currents.

7.05.00	Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.
7.06.00	Noise level for all the motors shall be limited to 85dB(A) except for BFP motor for which the maximum limit shall be 90dB(A). Vibration shall be limited within the limits prescribed in IS:12075 / IEC 60034-14 . Motors shall withstand vibrations produced by driven equipment. HT motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads.
7.07.00	In HT motors, at least four numbers simplex / two numbers duplex platinum resistance type temperature detectors shall be provided in each phase stator winding. Each bearing of HT motor shall be provided with dial type thermometer with adjustable alarm contact and preferably 2 numbers duplex platinum resistance type temperature detectors.
7.08.00	Motor body shall have two earthing points on opposite sides.
7.09.00	HT motors can be offered with either elastimould termination or dust tight phase separated double walled (metallic as well as insulated barrier) cable boxes. In case elastimould terminations are offered, then protective cover and trifurcating sleeves shall also be provided. In case cable box is offered, then Employer shall provide termination kit. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided in case of cable boxes.
7.10.00	The spacing between gland plate & centre of terminal stud shall be as per Table-I.
7.11.00	All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.
7.12.00	The motors shall be suitable for bus transfer schemes provided on the 11kV, 3.3 kV /415V systems without any injurious effect on its life.
7.13.00	For motors rated 2000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.
7.14.00	11kV and 3.3 kV motor Terminal Box shall be suitable for fault level of 750MVA for 0.12 sec and 250 MVA for 0.12 sec respectively. Elastimould termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.
7.15.00	The size and number of cables (for HT and LT motors) to be intimated to the successful bidder during detailed engineering and the contractor shall provide terminal box suitable for the same.
8.00.00	The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance) except for BFP motor.

	<p>(a) Below 110KW : 10.0</p> <p>(b) From 110 KW & upto 200 KW : 9.0</p> <p>(c) Above 200 KW & upto 1000KW : 10.0</p> <p>(d) From 1001KW & upto 4000KW : 9.0</p> <p>(e) Above 4000KW : 6 to 6.5</p>
10.00.00	TYPE TEST
10.01.00	HT MOTORS
10.01.01	The contractor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The bidder shall indicate the charges for each of these type tests separately in the relevant schedule of Section - VII- (BPS) and the same shall be considered for the evaluation of the bids. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the employer's engineer.
10.01.02	<p>The type tests shall be carried out in presence of the employer's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up,</p> <p>instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.</p>
10.01.03	In case the contractor has conducted such specified type test(s) within last ten years as on the date of bid opening, he may submit during detailed engineering the type test reports to the owner for waiver of conductance of such test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The owner reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor.
10.01.04	<p>Further the Contractor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED" and carried out within last ten years from the date of bid opening. These reports</p> <p>should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However if the</p>

10.01.05	<p>contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval.</p> <p>LIST OF TYPE TESTS TO BE CONDUCTED</p> <p>The following type tests shall be conducted on each type and rating of HT motor</p> <ul style="list-style-type: none"> (a) No load saturation and loss curves upto approximately 115% of rated voltage (b) Measurement of noise at no load. (c) Momentary excess torque test (subject to test bed constraint). (d) Full load test(subject to test bed constraint) (e) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp.,coolant flow and its temp. shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose. (f) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15 (g) Surge-withstand test on interturn insulation shall be as per clause no. 4.2 of IEC 60034, part-15
10.01.06	<p>LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED</p> <p>The following type test reports shall be submitted for each type and rating of HT motor</p> <ul style="list-style-type: none"> (a) Degree of protection test for the enclosure followed by IR, HV and no load run test. (b) Terminal box-fault level withstand test for each type of terminal box of HT motors only.
10.02.00	LT Motors
10.02.01	LT Motors supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last <i>ten</i> years from the date of bid opening.

10.02.02	<p>These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.</p> <p>However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval.</p>
10.02.03	<p>LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED</p> <p>The following type test reports shall be submitted for each type and rating of LT motor of above 50 KW only</p> <ol style="list-style-type: none"> 1. Measurement of resistance of windings of stator and wound rotor. 2. No load test at rated voltage to determine input current power and speed 3. Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors) 4. Full load test to determine efficiency power factor and slip . 5. Temperature rise test . 6. Momentary excess torque test. 7. High voltage test . 8. Test for vibration severity of motor. 9. Test for noise levels of motor(Shall be limited as per clause no 7.06.00 of this section) 10. Test for degree of protection and 11. Overspeed test. 12. Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1
10.03.00	<p>All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.</p>

10.04.00	<p>The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and “No design Change”. Minor changes if any shall be highlighted on the endorsement sheet.</p>

<p style="text-align: center;">TABLE - I</p> <p style="text-align: center;">DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS</p> <table> <tr> <th>Motor MCR in KW</th><th>Minimum distance between centre of stud and gland plate in mm</th></tr> <tr> <td>UP to 3 KW</td><td>As per manufacturer's practice.</td></tr> <tr> <td>Above 3 KW - upto 7 KW</td><td>85</td></tr> <tr> <td>Above 7 KW - upto 13 KW</td><td>115</td></tr> <tr> <td>Above 13 KW - upto 24 KW</td><td>167</td></tr> <tr> <td>Above 24 KW - upto 37 KW</td><td>196</td></tr> <tr> <td>Above 37 KW - upto 55 KW</td><td>249</td></tr> <tr> <td>Above 55 KW - upto 90 KW</td><td>277</td></tr> <tr> <td>Above 90 KW - upto 125 KW</td><td>331</td></tr> <tr> <td>Above 125 KW-upto 200 KW</td><td>203</td></tr> </table> <p>For HT motors the distance between gland plate and the terminal studs shall not be less than 500 mm.</p> <p>PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:</p> <p>NOTE: Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:</p> <table> <tr> <th>Motor MCR in KW</th><th>Clearance</th></tr> <tr> <td>UP to 110 KW</td><td>10mm</td></tr> <tr> <td>Above 110 KW and upto 150 KW</td><td>12.5mm</td></tr> <tr> <td>Above 150 KW</td><td>19mm</td></tr> </table>		Motor MCR in KW	Minimum distance between centre of stud and gland plate in mm	UP to 3 KW	As per manufacturer's practice.	Above 3 KW - upto 7 KW	85	Above 7 KW - upto 13 KW	115	Above 13 KW - upto 24 KW	167	Above 24 KW - upto 37 KW	196	Above 37 KW - upto 55 KW	249	Above 55 KW - upto 90 KW	277	Above 90 KW - upto 125 KW	331	Above 125 KW-upto 200 KW	203	Motor MCR in KW	Clearance	UP to 110 KW	10mm	Above 110 KW and upto 150 KW	12.5mm	Above 150 KW	19mm
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**TECHNICAL SPECIFICATION FOR
HYDROGEN GENERATION PLANT
2 X 800 MW NTPC GADERWARA STPP STAGE-I**

SPEC NO. PE-TS-394-168-A001

VOLUME-IIB

SECTION

REV.NO.0

DATE

SHEET

CABLES

	LT POWER CABLES																						
1.00.00	CODES & STANDARDS																						
1.01.00	<p>All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions. In case of conflict between this specification and those (IS : codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:</p> <table> <tr> <td>IS :1554 - I</td><td>PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.</td></tr> <tr> <td>IS : 3961</td><td>Recommended current ratings for cables</td></tr> <tr> <td>IS : 3975</td><td>Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.</td></tr> <tr> <td>IS : 5831</td><td>PVC insulation and sheath of electrical cables.</td></tr> <tr> <td>IS:7098 (Part -I)</td><td>Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100V.</td></tr> <tr> <td>IS : 8130</td><td>Conductors for insulated electrical cables and flexible cords.</td></tr> <tr> <td>IS : 10418</td><td>Specification for drums for electric cables.</td></tr> <tr> <td>IS : 10810</td><td>Methods of tests for cables.</td></tr> <tr> <td>ASTM-D -2843</td><td>Standard test method for density of smoke from the burning or decomposition of plastics.</td></tr> <tr> <td>IEC-754 (Part-I)</td><td>Tests on gases evolved during combustion of electric cables.</td></tr> <tr> <td>IEC-332</td><td>Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).</td></tr> </table>	IS :1554 - I	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.	IS : 3961	Recommended current ratings for cables	IS : 3975	Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.	IS : 5831	PVC insulation and sheath of electrical cables.	IS:7098 (Part -I)	Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100V.	IS : 8130	Conductors for insulated electrical cables and flexible cords.	IS : 10418	Specification for drums for electric cables.	IS : 10810	Methods of tests for cables.	ASTM-D -2843	Standard test method for density of smoke from the burning or decomposition of plastics.	IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables.	IEC-332	Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).
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2.00.00	TECHNICAL REQUIREMENTS														
2.01.00	The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.														
2.02.00	Cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses developed under steady state and transient operating conditions as specified elsewhere in this specification.														
2.03.00	Aluminium conductor used in power cables shall have tensile strength of more than 100 N/ sq.mm. Conductors shall be stranded.														
2.04.00	XLPE insulation shall be suitable for a continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250 deg C. PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.														
2.05.00	The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS : 5831.														
2.06.00	<p>For single core armoured cables, armouring shall be of aluminium wires/ formed wires. For multicore armoured cables, armouring shall be of galvanised steel as follows :</p> <table> <tr> <th>Calculated nominal dia. of cable under armour</th><th>Size and Type of armour</th></tr> <tr> <td>Upto 13 mm</td><td>1.4mm dia GS wire</td></tr> <tr> <td>Above 13 & upto 25mm</td><td>0.8 mm thick GS formed wire / 1.6 mm dia GS wire</td></tr> <tr> <td>Above 25 & upto 40 mm</td><td>0.8mm thick GS formed wire / 2.0mm dia GS wire</td></tr> <tr> <td>Above 40 & upto 55mm</td><td>1.4 mm thick GS formed wire /2.5mm dia GS wire</td></tr> <tr> <td>Above 55 & upto 70 mm</td><td>1.4mm thick GS formed wire / 3.15mm dia GS wire</td></tr> <tr> <td>Above 70mm</td><td>1.4 mm thick GS formed wire / 4.0 mm dia GS wire</td></tr> </table>	Calculated nominal dia. of cable under armour	Size and Type of armour	Upto 13 mm	1.4mm dia GS wire	Above 13 & upto 25mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire	Above 25 & upto 40 mm	0.8mm thick GS formed wire / 2.0mm dia GS wire	Above 40 & upto 55mm	1.4 mm thick GS formed wire /2.5mm dia GS wire	Above 55 & upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire	Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire
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Above 55 & upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire														
Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire														

2.06.01	The aluminium used for armouring shall be of H4 grade as per IS: 8130 with maximum resistivity of 0.028264 ohm mm ² per meter at 20 deg C. The sizes of aluminium armouring shall be same as indicated above for galvanized steel.
2.06.02	The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface of G.S.wire/ formed wire.
2.07.00	Outer sheath shall be of PVC as per IS: 5831 & black in colour. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties. (a.) Oxygen index of min. 29 (as per IS 10810 Part-58). (b.) Acid gas emission of max. 20% (as per IEC-754-I). (c.) Smoke density rating shall not be more than 60 % (as per ASTM D-2843).
2.08.00	Cores of the cables shall be identified by colouring of insulation. Following colour scheme shall be adopted: 1 core - Red, Black, Yellow or Blue 2 core - Red & Black 3 core - Red, Yellow & Blue 4 core - Red, Yellow, Blue and Black
2.09.00	For reduced neutral conductors, the core shall be black.
2.10.00	In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath. (a.) Cable size and voltage grade - To be embossed (b.) Word 'FRLS' at every 5 metre - To be embossed (c.) Sequential marking of length of the cable in metres at every one metre -To be embossed / printed The embossing shall be progressive, automatic, in line and marking shall be legible and indelible.

2.11.00	All cables shall meet the fire resistance requirement as per Category-B of IEC 332 Part-3.
2.12.00	Allowable tolerances on the overall diameter of the cables shall be +\2 mm maximum, over the declared value in the technical data sheets.
2.13.00	In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.
3.00.00	Cable selection & sizing
3.01.00	<p>LT Power cables shall be sized based on the following considerations:</p> <ul style="list-style-type: none"> (a) Rated current of the equipment (b) The voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage (c) Short circuit withstand capability <p>This will depend on the feeder type. For a fuse protected circuit, cable should be sized to withstand the let out energy of the fuse. For breaker controlled feeder, cable shall be capable of withstanding the system fault current level for total breaker tripping time inclusive of relay pickup time.</p> (d) The minimum conductor size shall be 6 sqmm for aluminium conductor cables and 2.5 sqmm for copper conductor cables. The constructional details of copper conductor cables shall be same as indicated for copper control cable.
302.00	<p>Derating Factors</p> <p>Derating factors for various conditions of installations including the following shall be considered while selecting the cable sizes:</p> <ul style="list-style-type: none"> a) Variation in ambient temperature for cables laid in air b) Grouping of cables c) Variation in ground temperature and soil resistivity for buried cables.
3.03.00	Cable lengths shall be considered in such a way that straight through cable joints are avoided.
3.04.00	Cables shall be armoured type if laid in switchyard area or directly buried.

3.05.00	All LT power cables of sizes more than 120 sq.mm. shall be XLPE insulated and preferable sizes are 1Cx150, 1Cx300, 1Cx630, 3Cx150 & 3Cx240 sq.mm.
4.00.00	<p>CONSTRUCTIONAL FEATURES</p> <p>(a.) 1.1 KV grade XLPE power cables shall have compacted aluminium conductor, XLPE insulated, PVC inner sheathed (as applicable), armoured/ unarmoured, FRLS PVC outer sheathed conforming to IS:7098. (Part-I).</p> <p>(b.) 1.1KV grade PVC power cables shall have aluminium conductor (compacted type for sizes above 10 sq.mm), PVC Insulated, PVC inner sheathed, armoured/ unarmoured, FRLS PVC outer sheathed conforming to IS:1554 (Part-I).</p>
5.00.00	<p>CABLE DRUMS</p> <p>(a) Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418.</p> <p>(b) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stencilled on both sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.</p> <p>(c) The standard drum length for power cables shall not be less than 500 meters. The length per drum shall be subjected to a maximum tolerance of +/- 5% of the standard drum length. The Employer shall have the option of rejecting cable drum with shorter lengths. For each size, the variance of total quantity, adding all the supplied drum lengths, from the ordered quantity, shall not exceed +/- 2%.</p>
5.00.00	TYPE TESTS
5.01.00	<p>General</p> <p>All equipments to be supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the</p>

	<p>date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.</p> <p>However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client /owners representative and submit the reports for approval.</p> <p>All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.</p> <p>The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.</p>																												
5.02.00	Type Tests																												
5.02.01	<p>The reports for the following type tests shall be submitted for one size each of LT XLPE and LT PVC Power cables. Size shall be decided by the employer during detailed engineering :</p> <table> <tr> <th>S.No.</th><th>Type test</th><th>Remarks</th></tr> <tr> <td colspan="3">For Conductor</td></tr> <tr> <td>1.</td><td>Resistance test</td><td></td></tr> <tr> <td>2.</td><td>Tensile test</td><td>For circular non-compacted conductors only</td></tr> <tr> <td>3.</td><td>Wrapping test</td><td>For circular non-compacted only</td></tr> <tr> <td colspan="3">For Armour Wires/ Formed Wires</td></tr> <tr> <td>4.</td><td>Measurement of Dimensions</td><td></td></tr> <tr> <td>5.</td><td>Tensile Test</td><td></td></tr> <tr> <td>6.</td><td>Elongation test</td><td></td></tr> </table>		S.No.	Type test	Remarks	For Conductor			1.	Resistance test		2.	Tensile test	For circular non-compacted conductors only	3.	Wrapping test	For circular non-compacted only	For Armour Wires/ Formed Wires			4.	Measurement of Dimensions		5.	Tensile Test		6.	Elongation test	
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7.	Torsion test	For round wires only
8.	Wrapping test	For aluminium wires / formed wires only.
9.	Resistance test	
10(a)	Mass of zinc coating test	For GS Formed wires/wires only
10(b)	Uniformity of zinc coating	For GS Formed wires /wires only
11.	Adhesion test	For GS Formed wires/wires only
For PVC/XLPE insulation & PVC Sheath		
12.	Test for thickness	
13.	Tensile strength & elongation	before ageing and after ageing tests
14.	Ageing in air oven	
15.	Loss of mass test	For PVC insulation and sheath only
16.	Hot deformation test	For PVC insulation and sheath only
17.	Heat shock test	For PVC insulation and sheath only
18.	Shrinkage test	
19.	Thermal stability test	For PVC insulation and sheath only
20.	Hot set test	For XLPE insulation only
21.	Water absorption test	For XLPE insulation only
22.	Oxygen index test	For outer sheath only
23.	Smoke density test	For outer sheath only

5.02.02	24.	Acid gas generation test	For outer sheath only
		For completed cables	
	25.	Insulation resistance test	
		(Volume resistivity method)	
	26.	High voltage test	
5.02.03	27.	Flammability test as per IEC-332 Part-3 (Category-B)	
	Acceptance Tests (as per QA table)		
	Routine Tests (as per QA table)		

	LT CONTROL CABLES																						
1.00.00	CODES & STANDARDS																						
1.01.00	<p>All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions. In case of conflict between this specification and those (IS : codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes :</p> <table> <tr> <td>IS :1554 - I</td><td>PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.</td></tr> <tr> <td>IS : 3961</td><td>Recommended current ratings for cables</td></tr> <tr> <td>IS : 3975</td><td>Low carbon galvanised steel wires, formed wire and tapes for armouring of cables.</td></tr> <tr> <td>IS : 4905</td><td>Methods for random sampling.</td></tr> <tr> <td>IS : 5831</td><td>PVC insulation and sheath of electrical cables.</td></tr> <tr> <td>IS : 8130</td><td>Conductors for insulated electrical cables and flexible cords.</td></tr> <tr> <td>IS : 10418</td><td>Specification for drums for electric cables.</td></tr> <tr> <td>IS : 10810</td><td>Methods of tests for cables.</td></tr> <tr> <td>ASTM-D -2843</td><td>Standard test method for density of smoke from the burning or decomposition of plastics.</td></tr> <tr> <td>IEC-754 (Part-I)</td><td>Test on gases evolved during combustion of electric cables.</td></tr> <tr> <td>IEC -332</td><td>Tests on Electric cables under fire conditions Part-3 : Tests on bunched wires or cables (category - B)</td></tr> </table>	IS :1554 - I	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.	IS : 3961	Recommended current ratings for cables	IS : 3975	Low carbon galvanised steel wires, formed wire and tapes for armouring of cables.	IS : 4905	Methods for random sampling.	IS : 5831	PVC insulation and sheath of electrical cables.	IS : 8130	Conductors for insulated electrical cables and flexible cords.	IS : 10418	Specification for drums for electric cables.	IS : 10810	Methods of tests for cables.	ASTM-D -2843	Standard test method for density of smoke from the burning or decomposition of plastics.	IEC-754 (Part-I)	Test on gases evolved during combustion of electric cables.	IEC -332	Tests on Electric cables under fire conditions Part-3 : Tests on bunched wires or cables (category - B)
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2.00.00	TECHNICAL REQUIREMENTS																						
2.01.00	The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground burried installation with chances of flooding by water.																						

2.02.00	Cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady state and transient operating conditions as specified elsewhere in this specification.														
2.03.00	Conductor of control cables shall be made of multi stranded, plain annealed copper.														
2.04.00	PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.														
2.05.00	The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS : 5831.														
2.06.00	<p>For multicore armoured cables, the armouring shall be of galvanised steel as follows :-</p> <table> <tr> <th>Calculated nominal dia of cable under armour</th><th>Size and Type of armour</th></tr> <tr> <td>1) Upto 13 mm</td><td>1.4mm dia GS wire</td></tr> <tr> <td>2) Above 13 upto 25 mm</td><td>0.8 mm thick GS formed wire / 1.6 mm dia GS wire</td></tr> <tr> <td>3) Above 25 upto 40 mm</td><td>0.8mm thick GS formed wire / 2.0mm dia GS wire</td></tr> <tr> <td>4) Above 40 upto 55mm</td><td>1.4 mm thick GS formed wire/ 2.5mm dia GS wire</td></tr> <tr> <td>5) Above 55 upto 70 mm</td><td>1.4mm thick GS formed wire / 3.15mm dia GS wire</td></tr> <tr> <td>6) Above 70mm</td><td>1.4 mm thick GS formed wire / 4.0 mm dia GS wire</td></tr> </table> <p>The gap between armour wire / formed wire shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface.</p>	Calculated nominal dia of cable under armour	Size and Type of armour	1) Upto 13 mm	1.4mm dia GS wire	2) Above 13 upto 25 mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire	3) Above 25 upto 40 mm	0.8mm thick GS formed wire / 2.0mm dia GS wire	4) Above 40 upto 55mm	1.4 mm thick GS formed wire/ 2.5mm dia GS wire	5) Above 55 upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire	6) Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire
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2.07.00	Outer sheath shall be of PVC(grade as applicable) and grey in colour . In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties.														

2.08.00	<p>(a) Oxygen index of min. 29 (As per IS:10810 (part-58))</p> <p>(b) Acid gas emission of max. 20% (As per IEC-754-I).</p> <p>(c) Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTM-D-2843.</p> <p>Cores of the cables of upto 5 cores shall be identified by colouring of insulation. Following colour scheme shall be adopted.</p> <p>1 core - Red, Black, Yellow or Blue</p> <p>2 core - Red & Black</p> <p>3 core - Red, Yellow & Blue</p> <p>4 core - Red, Yellow, Blue and Black</p> <p>5 core - Red, Yellow, Blue, Black and Grey</p>
2.09.00	<p>For cables having more than 5 cores, core identification shall be done by numbering the insulation of cores sequentially, starting by number 1 in the inner layer (e.g. say for 10 core cable, core numbering shall be from 1 to 10). The number shall be printed in Hindu-Arabic numerals on the outer surfaces of the cores. All the numbers shall be of the same colour, which shall contrast with the colour of insulation. The colour of insulation for all the cores shall be grey only. The numerals shall be legible and indelible. The numbers shall be repeated at regular intervals along the core, consecutive numbers being inverted in relation to each other. When the number is a single numeral, a dash shall be placed under neath it. If the number consists of two numerals, these shall be disposed one below the other and a dash placed below the lower numeral. The spacing between consecutire numbers shall not exceed 50 mm.</p>
2.10.00	<p>In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath :</p> <p>(a) Cable size and voltage grade - To be embossed</p> <p>(b) Word 'FRLS' at every 5 metre - To be embossed</p> <p>(c) Sequential marking of length of the cable in metres at every one metre. - To be embossed / printed.</p> <p>The embossing / printing shall be progressive, automatic, in line and marking shall be legible and indelible.</p>

2.11.00	All cables shall meet the fire resistance requirement as per Category-B of IEC 332 Part -3.
2.12.00	Allowable tolerances on the overall diameter of the cables shall be ± 2 mm maximum over the declared value in the technical data sheets.
2.13.00	In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.
2.14.00	Cable selection & sizing
2.14.01	<p>LT Control cables shall be sized based on the following considerations:</p> <ul style="list-style-type: none"> (a) Rated current of the equipment (b) The voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage (c) Short circuit withstand capability <p>This will depend on the feeder type. For a fuse protected circuit, cable should be sized to withstand the let out energy of the fuse. For breaker controlled feeder, cable shall be capable of withstanding the system fault current level for total breaker tripping time inclusive of relay pickup time.</p> (d) The minimum size of conductor shall be 1.5 sqmm
2.14.02	<p>Derating Factors</p> <p>Derating factors for various conditions of installations including the following shall be considered while selecting the cable sizes:</p> <ul style="list-style-type: none"> a) Variation in ambient temperature for cables laid in air b) Grouping of cables c) Variation in ground temperature and soil resistivity for buried cables.
2.14.03	Cable lengths shall be considered in such a way that straight through cable joints are avoided.
2.14.04	Cables shall be armoured type if laid in switchyard area or directly buried.

3.00.00	CONSTRUCTIONAL FEATURES
3.01.00	1.1 KV Grade Control Cables Control Cables shall have stranded copper conductor multicore PVC insulated, PVC inner-sheathed, armoured / unarmoured, PVC outer-sheathed conforming to IS:1554. (Part-I).
3.02.00	Cable Drums (a) Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof layer. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS : 10418. (b) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stencilled on both the sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled. (c.) The standard drum length for control cables shall not be less than 1000 metres. The length per drum shall be subjected to a maximum tolerance of +/- 5% of the standard drum length. The Employer shall have the option of rejecting cable drums with shorter lengths. For each size, the variance of total quantity, adding all the supplied drum lengths, from the ordered quantity, shall not exceed +/- 2%.
4.00.00	TESTS
4.01.00	GENERAL All equipments to be supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

	<p>However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client /owners representative and submit the reports for approval.</p> <p>All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.</p> <p>The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and “No design Change”. Minor changes if any shall be highlighted on the endorsement sheet.</p>	
4.02.00	TYPE TESTS:	
4.02.01	The Type tests reports for the following shall be submitted for one size of LT control cable :	
	S. No.	Type Test
		Remarks
	a)	For Conductor
	1.	Resistance test
	b)	For Armour Wires / Formed wires
	2.	Measurement of Dimensions
	3.	Tensile Test
	4.	Elongation test
	5.	Torsion test
		For round wire only
	6.	Winding test
		For Formed wires
	7.	Resistance test
	8.	Zinc Coating test
		For G.S. conductors only.
	c)	For PVC insulation & PVC Sheath
	9.	Test for thickness

	<p>10. Tensile strength and elongation test before ageing and after ageing</p> <p>11. Ageing in air oven</p> <p>12. Loss of mass test For PVC insulation and sheath only</p> <p>13. Hot deformation test For PVC insulation and sheath only</p> <p>14. Heat shock test For PVC insulation and sheath only</p> <p>15. Shrinkage test</p> <p>16. Thermal stability test For PVC insulation and sheath only</p> <p>17. Oxygen index test For outer sheath only</p> <p>18. Smoke density test For outer sheath only</p> <p>19. Acid gas generation test For outer sheath only</p> <p>d) For completed cables</p> <p>20. Insulation resistance test (Volume resistivity method)</p> <p>21. High voltage test</p> <p>23. Flammability test as per IEC - 332 Part-3 (Category-B)</p> <p>4.02.02 Acceptance Tests (as per QA table)</p> <p>4.03.00 Routine Tests (as per QA table)</p>



**TECHNICAL SPECIFICATION FOR
HYDROGEN GENERATION PLANT
2 X 800 MW NTPC GADERWARA STPP STAGE-I**

SPEC NO. PE-TS-394-168-A001

VOLUME-IIB

SECTION

REV.NO.0

DATE


SHEET


ELECTRICAL ACTUATORS WITH INTEGRAL STARTERS


CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
1.00.00	CODES AND STANDARDS:			
1.01.00	All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards/ codes as applicable.			
2.00.00	ELECTRIC ACTUATORS WITH INTEGRAL STARTERS			
2.01.00	TYPE:			
2.01.01	The actuators shall have integral starters along with over load relays with built in SPP (Single Phasing Preventer). A 415, 3 phase 3 wire power supply shall be given to the actuator from vendor's/employer's switch board as applicable through a switch fuse unit. Control voltage of the motor starter shall be 110 V AC / 24 V DC, derived suitably from 415V power supply.			
2.01.02	In case supplier's standard control voltage for Open/Close contactors is 110V AC, the same is acceptable if suitable Opto Isolation circuit is provided with coupling relays for 24 V DC command inputs.			
2.02.00	INTERFACES:			
2.02.01	<p>Open/Close command termination logic with position & torque Limit Switches, positioner circuit shall be suitably built in the PCB inside the actuator.</p> <p>(a) For Binary Drive (both ON-OFF and INCHING type) :- Open/Close command & status thereof and disturbance monitoring signal (common contact for Overload, Thermostat, control supply failure, L/R selector switch at local & other protections operated) shall be provided.</p> <p>Interface with the control system shall be through hardware signal only. Inter posing relays provided (with coil burden 2.5 VA) in the actuator shall be energized to initiate opening and closing, by 24V DC signal from the external control system.</p> <p>(b) For Modulating Drive:- the command to actuator shall be in form of 4-20mA signal. The necessary positioning circuit and motor protection shall be provided</p> <p>(c) Open/close command termination logic shall be suitably built inside actuator.</p>			
2.03.00	RATING : <p>(a) Supply Voltage & frequency: 415V +/- 10%, 3 Phase, 3 Wire 50HZ +/-5%.</p> <p>(b) Sizing:-</p> <p>Open/Close at rated speed against designed differential pressure at 90% of rated voltage.</p> <p>For isolating service:- Three successive open-close operations or 15 mins, whichever is higher. For regulating service 150 starts per hour or required cycles, whichever is higher.</p>			
2.04.00	CONSTRUCTION: <p>(a) Enclosure:</p> <p>Totally enclosed weatherproof minimum IP-55 degree of protection.</p>			

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
2.05.00	<p>(b) Gear Train :</p> <p>Metal (Fibre gears are not acceptable)) self-locking to prevent drift under torque switch (where ever applicable) spring pressure when motor is de-energized.</p> <p>(c) Manual Wheel:</p> <p>Shall disengage automatically during motor operation.</p> <p>MOTOR :</p> <p>(a) Type :</p> <p>Squirrel cage induction motor suitable for Direct On Line (DOL)starting.</p> <p>(b) Enclosure:</p> <p>Totally enclosed, self ventilated IP-55 degree of protection.</p> <p>(c) Insulation</p> <p>Class B or better. Temperature rise 70 Deg C. over 50 Deg C ambient</p> <p>(d) Bearings:</p> <p>Double shielded, grease lubricated antifriction.</p> <p>(e) Earth Terminals:</p> <p>Two</p> <p>(f) Protection:</p> <p>Single Phasing Protection, Over heating protection through Thermostat and wrong phase sequence protection shall be provided over and above other protection features standard to bidder's design Suitable means shall be provided to diagnose the type of fault locally.</p>		
2.06.00	<p>POSITION/TORQUE SWITCHES:</p>		
2.06.01	<p>Four nos. (2 each in open and close position) position limit switches and two nos. (one in open and other in close direction) torque switches each having two nos. NO and two nos. NC contacts shall be provided. A single shaft shall actuate all contacts of limit switches at each position.</p> <p>Limit switch and disturbance signals shall be available to DCS even when the power supply to the actuators is not available.</p> <p>Torque switches shall be bypassed in both the end positions with the other end Limit switches.</p> <p>Limit switches</p> <p>Limit switches shall be Silver plated with high conductivity and non –corrosive type. Contact rating shall be sufficient to meet the requirement of Control System subject to a minimum of 60 V, 6 VA rating. Protection class shall be IP-55.</p>		

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
2.07.00	LOCAL OPERATION:			
2.07.01	It shall be possible to operate the actuator locally also. Lockable local/remote selection shall be provided on the actuator.			
2.08.00	POSITION INDICATOR :			
2.08.01	To be provided for 0 to 100% travel.			
2.09.00	POSITION TRANSMITTER (FOR MODULATING/INCHING TYPE) :			
2.09.01	As required. Suitable for stabilized 4-20 mA signal, 2 wire inductive type, 24 volts DC operated.			
2.10.00	WIRING :			
2.10.01	Suitable voltage grade copper wire.			
2.11.00	TERMINAL BOX : <ul style="list-style-type: none"> (i) 9 pin plug and socket (1 no. per actuator to suit 4 pair 0.5 sq.mm. copper overall shielded (16 mm OD), instrumentation cable) suitably mounted in the starter box itself to terminate open/close command and status feedback signals with external control systems. (ii) Additional one number 9 pin plug and socket (to suit 4 pair 0.5 sq.mm copper (16 mm OD) individual and overall shielded instrumentation cable) suitably mounted in the starter box itself for actuators with 4-20 mA position transmitters. (iii) Necessary glands for power cables shall be provided. 			
2.12.00	TERMINAL BLOCK :			
2.12.01	650V grade. For power cables.			
2.13.00	SPACE HEATER :			
2.13.01	Space heater of suitable rating. The supply shall be derived from the main power supply available in the actuator.			
2.14.00	TYPICAL WIRING DIAGRAM :			
2.14.01	Refer Tender Drawing No. 0000-999-POI-A-063.			
3.00.00	TRAINING <p>Contractor shall provide training on Integral Actuator for Employer's personnel. The duration of the training shall be as elaborated in Part-C, Section-VI of technical specifications.</p>			

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.: PE-SS-394-145-I007	
			VOLUME II B	
			SECTION D	
			REV. NO. 00	DATE: 01.08.13
			SHEET 1	OF 3
Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
GENERAL *	* PROJECT	2X800 MW GADARWARA-TG		
	OFFER REFERENCE			
	* TAG NO. SERVICE			
	* DUTY	<input type="checkbox"/> ON / OFF <input type="checkbox"/> INCHING		
	* LINE SIZE (inlet/outlet): MATERIAL			
	* VALVE TYPE	<input type="checkbox"/> GLOBE <input type="checkbox"/> GATE <input type="checkbox"/> REG. GLOBE <input type="checkbox"/> BUTTERFLY		
	* OPENING / CLOSING TIME			
	* WORKING PRESSURE			
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%		
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY		
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY		
	CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, IP:55	
MECHANICAL POSITION INDICATOR		TO BE PROVIDED FOR 0-100% TRAVEL		
BEARINGS		DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.		
GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION		METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.		
SIZING		OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. FOR INCHING SERVICE - 150 STARTS/HR MINIMUM & FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM.		
HANDWHEEL	* REQUIRED	<input type="checkbox"/> YES <input type="checkbox"/> NO		
	* ORIENTATION	<input type="checkbox"/> TOP MOUNTED <input type="checkbox"/> SIDE MOUNTED		
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.			
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY		
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY		
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT-INCLUSIVE OF I.S. TOLERANCE		
	ACTUATOR APPLICABLE WIRING DIAGRAM	<input checked="" type="checkbox"/> ENCLOSED (BIDDER TO CONFIRM) A: <input type="checkbox"/> DRG. NO. 3-V-MISC-24227 R00 B: <input type="checkbox"/> DRG. NO. 3-V-MISC-24550 R00 C: <input checked="" type="checkbox"/> DRG. NO. 3-V-MISC-24283 R00 D: <input type="checkbox"/> DRG. NO. 4-V-MISC-90271 R11 E: <input type="checkbox"/> For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram		
	COLOUR SHADE	<input checked="" type="checkbox"/> BLUE (RAL 5012) <input type="checkbox"/>		
	PAINT TYPE (## Refer Notes)	<input checked="" type="checkbox"/> ENAMEL <input type="checkbox"/> EPOXY <input type="checkbox"/>		
	SHAFT RPM	BIDDER TO SPECIFY		
	OLR SET VALUE	BIDDER TO SPECIFY		
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY		
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY		
	@ PWR SUPP TO MTR / STARTER	415V, 3PH,3 wire, 50Hz AC		
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER <input type="checkbox"/> 230 V <input type="checkbox"/> 110 V		

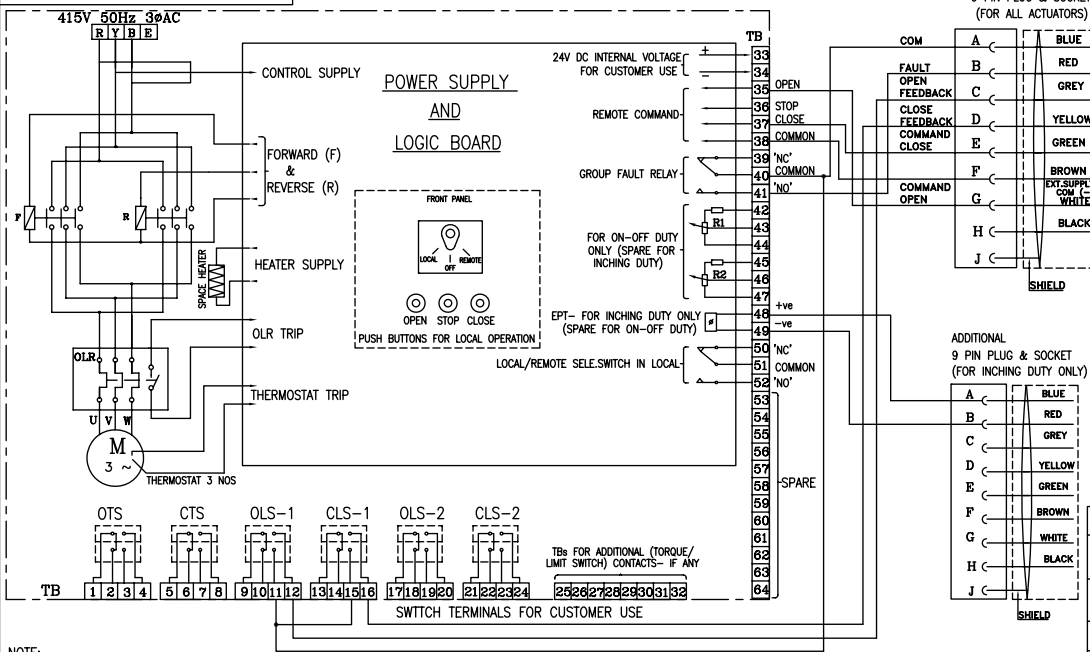
	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.: PE-SS-394-145-I007		
			VOLUME II B		
			SECTION D		
			REV. NO. 00	DATE: 01.08.13	
			SHEET 2	OF	3
Data Sheet A & B					
DATA SHEET-A (TO BE FILLED BY PURCHASER)				DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
	@ ENCLOSURE CLASS OF MOTOR	<input type="checkbox"/> IP 67 <input type="checkbox"/> FLAME PROOF			
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B			
	@ WINDING TEMP PROTECTION	<input checked="" type="checkbox"/> THERMOSTAT (3 Nos., 1 IN EACH PHASE) <input type="checkbox"/> -----			
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED			
INTEGRAL STARTER	INTEGRAL STARTER	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED			
	TYPE OF SWITCHING DEVICE	<input checked="" type="checkbox"/> CONTACTORS <input type="checkbox"/> THYRISTORS			
	TYPE	<input checked="" type="checkbox"/> CONVENTIONAL <input type="checkbox"/> SMART (NON-INTRUSIVE)			
	IF SMART				
	a) SERIAL LINK INTERFACE	<input type="checkbox"/> INTEGRAL <input type="checkbox"/> FIELD MOUNTED			
	b) SERIAL LINK PROTOCOL	<input type="checkbox"/> FOUNDATION FIELD-BUS <input type="checkbox"/> PROFI-BUS <input type="checkbox"/> DEVICE NET <input type="checkbox"/>			
	c) SERIAL LINK MEDIA	<input type="checkbox"/> TWISTED PAIR Cu-CBL <input type="checkbox"/> CO-AXIAL Cu-CBL <input type="checkbox"/> OFC			
	d) HAND HELD PROGRAMMER	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED			
	e) TYPE OF HAND HELD PROGRAMMER	<input type="checkbox"/> BLUETOOTH <input type="checkbox"/> INFRARED <input type="checkbox"/>			
	f) MASTER STATION	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED			
	g) MASTER STN INTRFACE WITH DCS	<input type="checkbox"/> MODBUS <input type="checkbox"/> TCP/IP			
	h) DETAILS OF SPECIAL CABLE	<input type="checkbox"/> ENCLOSED <input type="checkbox"/> NOT REQUIRED			
	STEP DOWN CONT. TRANSFORMER	<input type="checkbox"/> REQUIRED			
	OPEN / CLOSE PB	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED			
	STOP PB	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED			
	INDICATING LAMPS	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED			
	LOCAL REMOTE S/S	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED			
	STATUS CONTACTS FOR MONITORING	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED			
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY)			
	INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	<input checked="" type="checkbox"/> INTERPOSING RELAY <input type="checkbox"/> OPTO COUPLER <input type="checkbox"/> EITHER		
QUANTITY		<input checked="" type="checkbox"/> 2 NOs. <input type="checkbox"/> 3 NOs.			
DRIVING VOLTAGE		<input checked="" type="checkbox"/> 20.5 – 24V DC <input type="checkbox"/> _____ V DC			
DRIVING CURRENT		<input checked="" type="checkbox"/> 125mA MAX <input type="checkbox"/> _____ mA MAX			
LOAD RESISTANCE		<input checked="" type="checkbox"/> > 192 ohms - <25 k ohms <input type="checkbox"/> > _____ ohms - < _____ ohms			
TORQUE SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY			
	OPEN / CLOSE	<input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos. / <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos			
	CONTACT TYPE	2 NO + 2 NC			
	RATING	5A 240V AC AND 0.5A 220V DC			
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE			
	ACCURACY	+3% OF SET VALUE			
LIMIT SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY			
	OPEN : INT : CLOSE	<input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2 Nos.	2 Nos. (ADJ.)	<input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos.	
	CONTACT TYPE	2 NO + 2 NC			
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC			

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.: PE-SS-394-145-1007	
			VOLUME II B	
			SECTION D	
			REV. NO. 00	DATE: 01.08.13
			SHEET 3	OF 3
Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications)	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	MFR & MODEL NO.	BIDDER TO SPECIFY		
	TYPE	<input type="checkbox"/> ELECTRONIC (2 WIRE) R/I CONVERTER <input checked="" type="checkbox"/> ELECTRONIC (2 WIRE) CONTACTLESS		
	SUPPLY	<input checked="" type="checkbox"/> 24V DC <input type="checkbox"/>		
	OUTPUT	<input checked="" type="checkbox"/> 4-20mA		
	ACCURACY	$\pm 1\%$ FS		
SPACE HEATER	@SPACE HEATER	REQUIRED		
	@ POWER SUPPLY (NON INTEGRAL)	230V AC, 1 PH., 50 Hz		
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY		
	@ RATING			
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED		
	ENCL CLASS ACTUATOR/MOTOR T.B.	@ <input type="checkbox"/> IP 68 @ <input type="checkbox"/>		
	@ EARTHING TERMINAL	REQUIRED		
	PLUG & SOCKET (9 PIN) (FOR COMM, LS/TS FEED BACK, PoT)	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED <input checked="" type="checkbox"/> 2 NOS. <input type="checkbox"/>		
CABLE GLANDS	@ POWER CABLE GLAND	SIZE:-----		
	@ SPACE HEATER CABLE GLAND	SIZE:-----		
	OTHER CONTROL CABLE GLANDS-1	<input type="checkbox"/> 1No. for BFV of CW PUMP (Cable size 2Px1.5mm2)		
	OTHER CONTROL CABLE GLANDS-2	QUANTITY & SIZE :-----		
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY		_____ Kg.
NOTES: 1. SCOPE: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY. 2. CODES & STANDARDS: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH: IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722 3. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C. 4. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED. 5. THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION. THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE. 6. THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%. 7. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING. \$\$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE. ## EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.				
NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL
	ANUJ WADHWA	CHETAN MALIK	M.A.MANSOORI	NAME
				SIGNATURE
	20.06.2013	20.06.2013	20.06.2013	DATE
NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @ = TO BE FILLED BY ES				

ALL DIMENSIONS ARE IN MILLIMETRES. FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER RELEVANT QCP / QP.

3-V-MISC-24283

ON DRAWING



CONTACT DEVELOPMENT DIAGRAM

OTS	1-2	OPEN AT OVER TORQUE DURING OPENING TRAVEL
CTS	3-4	CLOSE AT OVER TORQUE DURING OPENING TRAVEL
	5-6	OPEN AT OVER TORQUE DURING CLOSING TRAVEL
	7-8	CLOSE AT OVER TORQUE DURING CLOSING TRAVEL
OLS-1	9-10	
	11-12	
CLS-1	13-14	
	15-16	
OLS-2	17-18	
	19-20	
CLS-2	21-22	
	23-24	
SWITCH	TERMINAL NO.	VALVE POSITION
	a	INTERMEDIATE
	b	FULL CLOSE

INDICATES CONTACT CLOSED
INDICATES CONTACT OPEN
CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS *	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS *	CTS	#
# - CLS NOT TO BE CONNECTED IN TRIP CIRCUIT				
* - BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)				

NOTE:-

- ALL TORQUE AND LIMIT SWITCHES (OTS, CTS, OLS1&2, CLS1&2) ARE WITH 2NO+2NC CONTACTS
'1NO+1NC' IS TERMINATED IN TBS 1-24, REMAINING CONTACTS ARE FOR INTERNAL USE.
ANY SPARE CONTACTS WHICH ARE NOT USED INTERNALLY ARE TO BE TERMINATED IN TBS 25-32
- CTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE)
- OTS - TORQUE SWITCHES FOR CCW ROTATION (OPEN)
- OLS-1, OLS-2 - LIMITSWITCHES FOR POSITION OPEN
- CLS-1, CLS-2 - LIMITSWITCHES FOR POSITION CLOSE
- EPT - ELECTRONIC POSITION TRANSMITTER
(CONTACTLESS TYPE, FOR INCHING DUTY)
- R1-R2-POTENTIOMETER 2 x 100 OHMS (FOR ON-OFF DUTY)
- FOR COMMANDS & EPT EITHER INTERNALLY GENERATED 24 VDC OR EXTERNAL SUPPLY OF 24VDC CAN BE USED
- M - MOTOR 3Φ 415V 50 Hz AC SUPPLY
- TORQUE SWITCH BYPASS WITH LIMITSWITCH BOTH ON OPEN & CLOSE DIRECTION TO BE DONE INTERNALLY.

REV	DATE	ALTERED
		CHD & APPD

CAUTION: The information on this drawing is the property of Bharat Heavy Electricals Ltd. and should not be used directly or indirectly in any way detrimental to the interest of the company.	TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT		ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS FOR NTPC PROJECTS (DRAWN FOR INTERMEDIATE POSITION OF VALVES)			
		BHARAT HEAVY ELECTRICALS LTD.,	DRN	NAME	SIGN	DATE
	365-121	UNIT: HIGH PRESSURE BOILER PLANT, TIRUCHIRAPPALLI-620014.	CHD	D.DINAKARAN	D.D	17.03.05
			APPD	KARUNACHALAM	K.A	17.03.05
	DEPT	VL	SCALE	WEIGHT (KG).	REFERENCE INFORMATIONS	
			NTS			
	TITLE			CARD CODE	DRAWING NO.	REV
	FOR ACTUATOR WITH INTEGRAL STARTER WITH PLUG & SOCKET FOR NTPC PROJECTS			U 01	3-V-MISC-24283	0

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**TECHNICAL SPECIFICATION FOR
HYDROGEN GENERATION PLANT
2 X 800 MW NTPC GADERWARA STPP STAGE-I**

SPEC NO. PE-TS-394-168-A001

VOLUME-IIB

SECTION

REV.NO.0

DATE

SHEET

	LIGHTING

	LIGHTING
1.00.00	GENERAL
1.01.00	This specification covers the general description of design, manufacture and construction features, testing, supply, installation and commissioning of the Lighting system equipment.
2.00.00	CODES AND STANDARDS
2.01.00	All standards and codes of practice referred to herein shall be the latest edition including all applicable official amendments & revisions. In case of conflict between this specification and those (IS codes, standards etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards & codes.
2.02.00	Lighting Fixtures and Accessories
	IS:1913 General and safety requirements for luminaires.
	IS:2148 Flame proof enclosures of electrical apparatus.
2.03.00	Lighting Panels, Switch-boxes, Receptacles and Junction Boxes
	IS:2147 Degree of protection provided by enclosures for low-voltage switchgear and control gear.
2.04.00	Electrical Installation Practices & Miscellaneous
	IS:1944 Code of practice for lighting of public thorough fare
	IS:3646 Code of practice for interior illumination.
	IS:5572 Classification of Hazardous areas (other than Mines) having flammable gases and Vapours for electrical installation
	IS:6665 Code of practice for industrial lighting.
	National Electrical Code
	Indian Electricity Rules.
	Indian Electricity Act

3.00.00	<p>DESIGN PHILOSOPHY</p> <ol style="list-style-type: none"> 1. A comprehensive illumination system shall be provided for the Hydrogen plant 2. All lighting system shall be automatically controlled by synchronous timer or photocell. Provision to bypass the timer or photocell shall be provided in the panel. 3. In the Off site area / buildings DC lighting shall be provided by self-contained 4hours duration Emergency lighting fixtures. Each shall be provided with Ni-cd battery, battery Charger & 2x10 W fluorescent lamps 4. The system shall include distribution boards, normal/ emergency lighting panels, lighting fixtures, junction boxes, receptacles, switch boards, conduits, cables and wires, etc. The system shall cover all interior and exterior lighting such as area lighting. The constructional features of lighting distribution boards shall be similar to AC/DC distribution boards described in chapter of LT Switchgear. Outgoing circuits in LPs shall be provided with MCBs of adequate ratings. 5. The illumination system shall be designed on the basis of best engineering practice and shall ensure uniform, reliable, aesthetically pleasing and glare free illumination. The diffusers/ louvres used in fluorescent fixtures shall be made of impact resistant polystyrene sheet and shall have no yellowing property over a prolonged period. 6. Apart from maintenance factor as given below, Temperature correction factor shall be considered in the lighting design for fluorescent fixtures located in non air conditioned area. Similarly the correction factor towards ageing of lamps , as recommended by the lamp manufacturer shall also be considered in the lighting design. <ol style="list-style-type: none"> (a) Office area air conditioned : 0.8 (b) Office area non air conditioned and other indoor area : 0.7 (c) Dust prone and outdoor area : 0.6 7. All outdoor fixtures shall be weather proof. 8. Wires of different phase shall normally run in separate conduit.

	<p>9. Power supply shall be fed from 415V normal AC supply, through suitable number of conveniently located lighting panels (LP). AC lighting supply shall be isolated from main supply by 2X100 % isolation transformers of rating 50KVA/100KVA for 10/15 nos. outgoing feeder with changeover switch facility. The isolation transformer shall be fed from two different bus sections of MCC. Fault level shall be restricted to 3 KA at Lighting Panels.</p> <p>10. Atleast one 6/16A, 240V AC universal socket outlet with switch shall be provided in offices, cabins, etc. 20A, 240V AC industrial receptacle with switch shall be provided strategically in all industrial area. Suitable number of 63A,3ph., 415V AC industrial receptacles shall be provided for entire plant for welding purposes, particularly near all major equipment and at an average distance of 50m. Atleast one 63A,3ph.,415V AC receptacle shall be provided in each off site building.</p> <p>11. Average lux level of 150 lux shall be maintained in hydrogen plant and 20 lux shall be maintained in outdoor areas. The type of fixtures, LP, JB, and receptacle used in Hydrogen generation plant building shall be suitable for group-IIC as per IS:2148 or Class-I division-II as per NEC.</p>
3.01.00	<p>Ballasts</p> <p>(a) All HPSV and HPMV lamp fixtures shall be provided with wire-wound ballasts. All fluorescent fixtures except for Class-I, Div-IIC fittings/ increased safety fittings (Div-II/Hazardous Area) installed area shall be provided with electronic ballasts.</p>
3.02.00	All luminaires and their accessories and components shall be of type readily replaceable by available Indian makes.
3.03.00	<p>Fans & Regulator</p> <p>Ceiling Fans, to be provided in non air conditioned office/control room area, shall be suitable for operation on 240 V+/- 10%, 50 Hz, AC supply comprising of class 'E' insulated copper wound single phase motor, 1200mm sweep, aerodynamically designed well balanced Aluminum blades (3 Nos.), down rod, die cast aluminum housing, capacitor, suspension hook, canopies etc. finished in stove enameled white. Power factor of fans shall not be less than 0.9. Each fan shall cover approximately 10sq.m. area.</p>
3.04.00	<p>Switch Box</p> <p>Switch boxes shall be made of 1.6 mm thick, MS sheet with 3 mm. thick decorative, perspex cover. Switchbox shall be hot dip galvanised</p>

3.05.00	Junction boxes
3.05.01	Junction box for lighting fixtures shall be deep drawn or fabricated type made of min. 1.6 mm thick CRCA Sheet. The box shall be hot dip galvanised.
3.06.00	Conduits, Fittings & Accessories
3.06.01	Galvanised heavy duty steel conduits for normal area and galvanised heavy duty steel conduits with an additional epoxy coating for corrosive area shall be offered. Alternatively glass reinforced epoxy conduits with comparable compressive and impact strength with that of heavy duty steel conduits may be offered.
3.06.02	Rigid Steel Conduits (a) Rigid steel conduits shall be heavy duty type, hot dip galvanised conforming to IS : 9537 Part-I & II shall be suitable for heavy mechanical stresses, threaded on both sides and threaded length shall be protected by zinc rich paint. Conduits shall be smooth from inside and outside.
3.06.03	Flexible Steel Conduits Flexible conduit shall be water proof and rust proof made of heat resistant lead coated steel.
3.06.04	Pull-out Boxes Pull out boxes shall be provided at approximately 4 (four) metre interval in a conduit run .Boxes shall be suitable for mounting on Walls, Columns, Structures, etc. Pull-out boxes shall have cover with screw and shall be provided with good quality gasket lining. Pull out boxes used outdoor shall be weather proof type suitable for IP :55 degree of protection and those used indoor shall be suitable for IP :52 degree of protection. Pull out box & its cover shall be hot dip galvanised.
3.07.00	Lighting Wires Lighting wires shall be 1100 V grade, light duty PVC insulated unsheathed, stranded copper/aluminum wire for fixed wiring installation. colour of the PVC insulation of wires shall be Red, Yellow, Blue and Black for R,Y,B phases & neutral, respectively and white & grey for DC positive & DC negative circuits, respectively. Minimum size of wire shall not be less than 1.5.sq.mm. for copper and 4 sq.mm. for aluminum.
4.00.00	TESTS
4.01.00	All equipment to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the

	<p>date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.</p>								
4.02.00	<p>However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval.</p>								
4.03.00	<p>All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.</p>								
4.04.00	<p>The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design change". Minor changes if any shall be highlighted on the endorsement sheet.</p>								
4.05.00	<p>Selection of samples for type test, acceptance test & routine test and acceptance criteria for all the items shall be as per relevant I.S</p>								
4.06.00	<p>Type test reports of the following items as per relevant standards shall be submitted for approval.</p> <table border="1"> <thead> <tr> <th>SL NO.</th><th>DESCRIPTION</th></tr> </thead> <tbody> <tr> <td>i.</td><td>Lighting panel of each type (Degree of Protection)</td></tr> <tr> <td>ii.</td><td>Junction Box of each type</td></tr> <tr> <td>iii.</td><td>Receptacles of each rating (Degree of Protection)</td></tr> </tbody> </table>	SL NO.	DESCRIPTION	i.	Lighting panel of each type (Degree of Protection)	ii.	Junction Box of each type	iii.	Receptacles of each rating (Degree of Protection)
SL NO.	DESCRIPTION								
i.	Lighting panel of each type (Degree of Protection)								
ii.	Junction Box of each type								
iii.	Receptacles of each rating (Degree of Protection)								
4.07.00	<p>Acceptance Test and Routine Test</p>								
4.07.01	<p>All lighting fixtures, lamps and other items shall be subjected to acceptance and routine test, as per relevant specified standards.</p>								
4.07.02	<p>Junction boxes, switch boxes, receptacle enclosure etc. shall be subjected to physical and dimensional checks.</p>								

4.08.00	<p>Galvanizing Tests</p>
4.08.01	<p>The quality of galvanizing shall be smooth, continuous, free from flux stains and shall be inspected visually.</p>
4.08.02	<p>In addition following tests shall be conducted as acceptance tests.</p> <ul style="list-style-type: none"> (a) Uniformity of coating - The coating of any article shall withstand four 1minute dips in standard copper sulphate solution without the formation of an adherent red spot of metallic copper upon the basic metal. (b) The quality of cadmium/zinc plating on items with screw threads shall be free from visible defects such as unplated areas, blisters and modules and shall be inspected visually. (c) In addition, the plating thickness shall be determine microscopically/chemically or electronically.



**TECHNICAL SPECIFICATION FOR
HYDROGEN GENERATION PLANT
2 X 800 MW NTPC GADERWARA STPP STAGE-I**

SPEC NO. PE-TS-394-168-A001

VOLUME-IIB

SECTION

REV.NO.0

DATE

SHEET

CABLING, EARTHING & LIGHTNING PROTECTION

	CABLING, EARTHING & LIGHTNING PROTECTION
1.00.00	CODES AND STANDARDS:
1.01.00	<p>All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards/ codes as applicable.</p> <p>IS:2309, IEEE:142, IEEE-80, IS:1255, IS:3043, DIN 46235.</p>
2.00.00	REQUIREMENTS
2.01.00	<p>The complete cable support system shall be supplied and installed for the entire work is in the bidder's scope. The system shall enable proper laying of all power, control, instrumentation and telephone cables, and shall provide necessary mechanical protection, ventilation and segregation for them as per latest engineering practices and cable manufacturers' recommendation .The cable installation shall be carried out as per IS:1255. All hardware and anchoring arrangement shall be included. All steel members shall be hot dip galvanized. Cable shall be terminated using double compression type cable glands. Cable lugs for power cables shall be tinned copper solderless crimping type conforming to DIN 46235 suitable for aluminum compacted conductor cables.</p>



**TECHNICAL SPECIFICATION FOR
HYDROGEN GENERATION PLANT
2 X 800 MW NTPC GADERWARA STPP STAGE-I**

SPEC NO.PE-TS-394-168-A001

VOLUME-IIB


SECTION

REV.NO.0

DATE

SHEET

LT SWITCHGEAR

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	LT SWITCHGEAR			
1.00.00	CODES AND STANDARDS			
1.01.00	All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards/ codes as applicable.			
	IEC: 60947, IS: 13947, IEC: 60439, IS: 8623, IEC: 61850			
2.00.00	TYPE			
	Circuit Breakers	Shall be air break, three pole, spring charged, and horizontal drawout type, suitable for electrical operation.		
	Switchgear	Fully drawout type Single Front		
	MCC	Fully drawout type Double Front.		
	ACDB / DCDB	Fixed type Double Front		
3.00.00	SYSTEM PARAMETERS			
	415VAC +/- 10 %(SOLIDLY GROUNDED)			
	50 Hz +3%/-5%			
	Fault Level: 45kA RMS for 1sec (105 KA PEAK)			
	240 V DC nominal (187V DC -242V DC) isolated type			
4.00.00	TEMPERATURE RISE			
	The temperature rise of the horizontal and vertical busbars and main bus link including all power draw out contacts when carrying 90% of the rated current along the full run shall in no case exceed 55 deg. C with silver plated joints and 40 deg. C with all other types of joints over an ambient of 50 deg C. The temperature rise of the accessible parts / external enclosures expected to be touched in normal operation shall not exceed 20 deg. C. The temperature rise of manual operating means shall not exceed 10 deg. C for metallic & 15 deg. C for insulating material. Temperature rise for the busbars shall be carried out at 90% of the rated current. The above temperature rise limits are applicable for busducts also without any current derating.			


CLAUSE NO.	<div> <p>TECHNICAL REQUIREMENTS</p> </div> <div> </div>
5.00.00	OPERATIONAL REQUIREMENTS
5.01.00	Breakers
5.01.01	Breakers shall have anti-pumping feature.
5.01.02	The incomer and bus coupler breakers for switchgear shall be electrically operated with Numerical communicable relays.
5.01.03	Breakers shall have inherent fault making and breaking capacities. They shall have shunt trip coils. All breakers shall have built in interlocks for equipment and personnel safety.
5.01.04	Paralleling of two supplies shall be avoided by interlocking except for switchgear where auto-changeover is provided. Breaker contact multiplication, if required, shall be through latch relay.
5.01.05	Mechanical tripping shall be through red 'Trip' push button outside the panels for breakers, and through control switches for other circuits.
5.01.06	Provision of mechanical closing of breaker only in 'Test' and 'Withdrawn' position shall be made. Alternatively, mechanical closing facility should be normally inaccessible, accessibility rendered only after deliberate removal of shrouds. It shall be possible to close the door with breaker in test position.
5.01.07	Clear status indication for each circuit shall be provided through lamps, switch positions or other mechanical means.
5.02.00	Switches, Contactors and Fuses
5.02.01	Incomers for MCCs and DBs rated below 250A shall be load break isolators.
5.02.02	Motor starter contactors shall be of air break, electromagnetic type suitable for DOL starting of motor, and shall be of utilization category AC-3 for ordinary and AC-4 for reversing starters. For conveyor motors, minimum rating of power contactors shall be 200% of the full load current of the motors. For other motors minimum rating of power contactors shall be 160% of full load current of motor. DC contactor shall be of DC-3 utilization category.
5.02.03	Fuses shall be HRC type with operation indicator. Isolating switches shall be of AC-23A category when used in motor circuit, and AC-22A category for other applications. Fuse switch combination shall be provided wherever possible.
5.02.04	The 250A & above feeders up to 630A shall have MCCB. MCCB shall be provided with Microprocessor based inbuilt front adjustable releases (overload & short circuit)

CLAUSE NO.	TECHNICAL REQUIREMENTS	<div>एन टी पी सी NTPC</div>		
	<p>and shall have adjustable earth fault protection unit also. MCCB shall have current limiting feature. ON and OFF position of the operating handle of MCCB shall be displayed and the rotary operating handle shall be mounted on the door of the compartment housing MCCB. The compartment door shall be interlocked mechanically with the MCCB, such that the door can not be opened unless the MCCB is in OFF position. MCCB shall be provided with padlocking facility to enable the operating mechanism to be padlocked.</p>			
5.03.00	Panels			
5.03.01	All switchgears, MCCs, DBs, panels, modules, local starters and push buttons shall have prominent engraved identification plates.			
5.03.02	Local push button stations shall have metal enclosure of die cast aluminium or rolled sheet steel of 1.6mm thickness & shall be of DOP IP55. The DOP shall be IP-65 in case the same are located in dusty areas. Push buttons shall be of latch type with mushroom knobs.			
5.03.03	Where breaker / starter module front serves as compartment cover, suitable blanking covers, one for each size of modules per switchboard shall be supplied for use when carriage is withdrawn.			
5.03.04	All non-current carrying metal work of boards / panels shall be effectively bonded to earth bus of galvanized steel, extending throughout the switchboard / MCC / DB. Positive earthing shall be maintained for all positions of chassis and breaker frame.			
5.03.05	Suitable trolley arrangement shall be provided for breaker / starter modules. Two trolleys per switchgear room shall be provided so that top most breaker module of all types, sizes and rating can be withdrawn on trolley and lowered for maintenance purpose.			
5.03.06	It should be possible to carryout maintenance on a feeder with adjacent feeders alive.			
5.03.07	DC fuse board shall consist of: -1 no.63A switch as incomer with meters, lamps and auxiliary contactors. -8 nos. outgoing feeders with 16A HRC fuses.			
5.03.08	AC fuse board shall consist of: -1 no 63A TPN SFU as incomer with lamps and meters. -9 nos.16A SPN SFU & 3 nos.16A TPN SFU as outgoing.			

CLAUSE NO.	TECHNICAL REQUIREMENTS	<div>एनटीपीसी NTPC</div>		
5.04.00	Control, Protection & Metering Requirements			
5.04.01	Control circuits shall operate at suitable voltage of 110V AC or 240V DC / 120V DC. Necessary control supply transformers having primary and secondary fuses shall be provided for each MCC, 2 x 100% per bus section. However the breakers shall operate on 240V DC. The auxiliary bus bars for control supply shall be segregated from main bus bars. The control supplies shall be monitored.			
5.04.02	Contractor shall fully co-ordinate overload and short circuit tripping of breaker with upstream and down stream breakers / fuses / MCCBs / motor starters. Various equipments shall meet requirement of Type-II class of coordination as per IEC.			
5.04.03	The protective relays shall be communicable numerical relays. These numerical relays shall be of types as proven for the application and shall be subject to Employer's approval. Numerical relays shall have appropriate setting ranges, accuracy, resetting ratio and other characteristics to provide required sensitivity. All equipments shall have necessary protections as detailed in the standard scheme drawings.			
5.04.04	All equipments shall have necessary protections. However, following minimum protections shall be provided: 1) Contactor controlled motor feeders (Motors below 110 kW) a) Instantaneous short circuit protection on all phases through HRC cartridge type fuses rated for 80 kA rms (prospective breaking capacity at 415V). b) Thermal overload protection c) Single phasing protection for motors protected by fuses 2) Incomers / bus coupler / outgoing breaker feeders other than motor feeders. a) Three phase Overcurrent protection (50) b) Three phase earth fault protection (50N3) c) Restricted earth fault protection for transformer incomers (64R) 3) Breaker controlled motor feeders(Motors 110KW & above) a) Thermal Overload Protection (50I)			


CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	<p>b) Three phase Short Circuit Protection (50)</p> <p>c) Earth Fault Protection (50N/50N2)</p> <p>d) Thermal Overload Alarm (50A)</p>			
5.05.00	General requirements of Numerical Relays			
5.05.01	All relays and timers shall be rated for control supply voltage as mentioned elsewhere under parameters and shall be capable of satisfactory continuous operation between 70-120% of the rated voltage. Making, carrying and breaking current ratings of their contacts shall be adequate for the circuits in which they are used. Interrogation voltage for the binary inputs shall be suitably selected to ensure avoidance of mal-operation due to stray voltages.			
5.05.02	All Numerical relays shall have communications on two ports, local front port for communication to laptop and a second port on IEC 61850 to communicate with owner's data concentrator through LAN.			
5.05.03	All Numerical Relays shall have features for electrical measurement including voltage, current, power (active / reactive) and energy parameters.			
5.05.04	All Numerical Relay shall have key pad / keys to allow relay settings from relay front. All hand reset relays shall have reset button on the relay front. Relay to be self or hand reset shall be software selectable. Manual resetting shall be possible from remote.			
5.05.05	The protective relays shall have at least 10 Nos. programmable potential free contacts. Programmable Auxiliary relays shall have contacts as required.			
5.05.06	For control from DDCMIS, 24V DC signal shall be provided from DDCMIS to the numerical relays. Preferably, no separate coupling relays shall be provided.			
5.05.07	Trip circuit supervision shall be provided for all feeders to monitor the circuit breaker trip circuit both in pre trip and post trip conditions.			
5.05.08	Schematics requiring auxiliary relays / timers for protection function shall be a part of Numerical Relay. The number of auxiliary relay and timer function for protection function shall be as required by the scheme. Auxiliary relays for interlocking purpose shall be of self reset type.			
5.05.09	The numerical processor shall be capable of measuring and storing values of a wide range of quantities, all events, faults and disturbance recordings with a time			

CLAUSE NO.	TECHNICAL REQUIREMENTS	<div>एनटीपीसी NTPC</div>	
	stamping using the internal real time clock. Battery back up for real time clock in the event of power supply failure shall be provided.		
5.05.10	Sequence of events shall have 1ms resolution at device level.		
5.05.11	Ethernet switches shall be “substation hardened” and shall comply to IEC61850-3 for communications and environment requirements. The Ethernet switches shall be of managed type with four (4) numbers Single-mode Fibre Optic cable ports and required number of Copper ports to achieve the owners’ LAN configuration. One (1) no. of Ethernet switch per switch board shall be provided & these switches shall be mounted inside the switchgear Panels.		
5.05.12	<p>In case of remote controlled breaker panels, following shall be ensured.</p> <p>The circuit breaker will normally be controlled from remote control panels (employer’s DDCMIS) through closing and shunt trip coils. The Local control console of the relay flush mounted on the switchgear would normally be used only for testing of circuit breaker in isolated position, and for tripping it in an emergency. Provision for closing & tripping of the circuit breaker locally from laptop through serial port shall be possible to facilitate commissioning activities. The basic control scheme of breaker feeders shall be developed as per the schematic logics in the relay. The schematics shall be developed in soft inside the relay. Numerical relays shall be interfaced with employer’s DDCMIS through 24V DC signal for closing / opening operations.</p>		
5.05.13	Hardwired contacts from the relay shall be wired to PLC / DCS system as per requirements. The numerical relay shall be capable of measuring and storing values of a wide range of quantities, events, faults and disturbance recordings.		
5.05.14	The alarm / status of each of protection function and trip operation shall be communicated to PLC / DCS. The numerical relays shall have built in feature / hardware interface to provide such inputs to PLC / DCS for analog / digital values.		
5.05.15	It shall be possible to carryout open / close operation of breakers from a laptop by interfacing through the relay front port during initial commissioning.		
5.06.00	<p>Meters / instruments</p> <p>All meters / instrument shall be flush mounted on front panel, at least 96 sq.mm. size with 90 degree linear scales and accuracy class of 2.0 or better.</p>		
5.06.01	All motors of 30kW and above upto 100kW shall have an digital Energy Meter with analog current output. Each bus-section shall have bus VT, voltmeter with selector switch, and other relay and timers required for protection. Adequate control and selector switches, push buttons and indicating lamps shall be provided. Thermostatically controlled space heaters with switches shall be provided to prevent condensation.		

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5.07.00	Control from Remote Necessary hardware shall be provided in the switchgear panel like coupling relays (if required) of 24V DC with max. burden of 2.5VA, auxiliary relays, current / voltage transducers (4-20mA, dual output) etc. to effect interlocks, exchange information / status and exercise control from remote.			
6.00.00	DESIGN AND CONSTRUCTIONAL FEATURES			
6.01.00	All 415V switch gear motor control centers (MCCs), AC & DC distribution boards (DB s), etc shall have two incomers and one bus-coupler arrangement with following features: 1) Shall be of metal enclosed, indoor, floor mounted and free standing type. 2) All frames and load bearing members shall be fabricated using mild steel structural sections or pressed and shaped cold rolled sheet steel of thickness not less than 2mm. 3) Frame shall be enclosed in cold rolled sheet steel of thickness not less than 1.6mm.Doors and covers shall also be of cold rolled sheet steel of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary. Removable gland plates of thickness 3mm (hot/cold rolled sheet steel) or 4 mm (non-magnetic material) shall be provided for all panels. 4) All switchboards / panels shall be of dust and vermin proof. All cutouts shall have EPDM / Neoprene gaskets. 5) All switchboards, MCCs and DB s shall have following distinct vertical sections. a) Completely enclosed bus bar compartment for horizontal and vertical bus bars. b) Completely enclosed switchgear compartments (one for each circuit housing circuit breakers, motor starter or switch-fuse feeder). c) Compartment for cable alley or cable box for power and control cables. Cable terminations located in cable alley shall be designed to meet the Form IVb Type 7 (as per IEC 60439) for safety purpose. The termination for each module shall have its own integral glanding facility.			

CLAUSE NO.	TECHNICAL REQUIREMENTS	<div>एनटीपीसी NTPC</div>		
	<p>In case of cable boxes provided in distribution boards, they shall be segregated with complete shrouding for individual feeders at the rear for direct termination of cables.</p> <p>d) For cable connection to circuit breaker, a separately enclosed cable compartment shall also be acceptable.</p> <p>e) Compartment for relays and other control devices associated with a circuit breaker, wherever necessary.</p> <p>f) The switchboards / MCC / DBs of 1600A & above rating shall be of DOP IP42 & of IP52 for less than 1600A rating.</p> <p>g) All 415V switchgears, MCCs, AC & DC distribution boards etc. shall be painted by powder coating process. Paint shade for complete panels excluding end covers shall be RAL9002 & RAL5012 for extreme end covers of all boards.</p> <p>h) All draw out modules shall have distinct service, test and isolated positions with provision of external pad locking facility in each position. Power contacts shall get disconnected in both test and isolated positions whereas the control contacts shall get disconnected in isolated position only.</p> <p>6) Busbars shall be of high conductivity aluminium alloy or copper.</p> <p>7) The cross section of the horizontal bus bars shall be uniform through out the length of the switchboard and both horizontal as well as vertical bus bars shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents. Neutral bus bar short circuit strength shall be same as the main bus bars.</p> <p>8) Minimum air clearance in air between phases and phase-earth shall be 25 mm for busbars and cable terminations. For all other components, the Clearances shall be at least 10mm. Wherever above is not possible except for horizontal and vertical busbars, insulation shall be provided by anti tracking sleeving or barriers. However for horizontal and vertical busbars, clearances specified above shall be maintained even when busbars are insulated / sleeved. Entire busbar system shall be insulated with PVC sleeves.</p>			

CLAUSE NO.	TECHNICAL REQUIREMENTS		<div>एनटीपीसी NTPC</div>												
	<div>9) Busbar insulators shall be of track-resistant high strength non-hygroscopic, non-combustible type and suitable to withstand stresses due to over-voltages and short circuit current. Insulators and barrier of inflammable material such as Hylam shall not be accepted.</div> <div>10) All types of relays and timer shall be subject to Employer's approval. They shall be flush mounted with connections from inside, and shall have transparent & dust tight cover, removable from front, drawout construction for easy replacement and testing facility. The auxiliary relays and timer may be provided in fixed cases.</div> <div>11) Terminal Blocks Terminal blocks shall be 650V grade, 10Amps rated, made up of unbreakable polyamide 6.6 grade. The terminals shall be either screw type or screw-less (spring loaded) / cage clamp type with lugs. Marking on terminal strips shall correspond to the terminal numbering in wiring diagrams. All metal parts shall be of non-ferrous material. In case of screw type terminals the screw shall be captive, preferably with screw locking design. Maxi terminal / cage clamp type terminal blocks shall be provided for signals to be interfaced with DDCMIS / PLC.</div> <div>12) The switchgears/MCC shall be designed to offer adequate level of safety to operating/ maintenance personnel. Means shall be provided to prevent access to the live part to avoid accidents during service as well as maintenance period. Bidder shall bring out the safety means provided to achieve above. A detailed instruction plate suitable for wall mounting shall be provided for each switchgear/MCC room describing various safe operating procedure/safety precautions for safe operation and maintenance of switchgear/MCC.</div> <div>13) All current and voltage transformers as required for metering & protection specified shall be completely encapsulated cast resin insulated type. Incomers from transformers shall have CTs for transformer REF protection. The accuracy shall be as follows:</div> <table><tr><td></td><td>CTs</td><td>PTs</td></tr><tr><td>Protection</td><td>5P20,5VA</td><td>3P</td></tr><tr><td>Metering</td><td>1.0</td><td>0.5</td></tr><tr><td>REF</td><td>PS</td><td></td></tr></table>				CTs	PTs	Protection	5P20,5VA	3P	Metering	1.0	0.5	REF	PS	
	CTs	PTs													
Protection	5P20,5VA	3P													
Metering	1.0	0.5													
REF	PS														

CLAUSE NO.	TECHNICAL REQUIREMENTS		
6.02.00	Indicating lamps shall be cluster LED type. All overload relays shall have overload reset push button.		
6.03.00	Switchgear / MCC shall have bottom cable entry.		
6.04.00	Contractor shall provide minimum one spare feeder for each type and rating of the outgoing feeders on each MCC / Switchgear.		
7.00.00	TYPE TESTS		
7.01.00	GENERAL		
	(a.) All equipments to be supplied shall be of type tested design. The Contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.		
	(b.) In case the Contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract at no additional cost either at third party lab or in presence of client/owner's representative and submit the reports for approval.		
	(c.) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.		
	(d.) The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.		
7.03.00	L. T. SWITCHGEAR		
	The following type test certificates on each type & rating of L.T. Switchgear and MCC panel shall be submitted.		
	(a.) Short time withstand test.		
	(b.) Temperature rise test.		

CLAUSE NO.	TECHNICAL REQUIREMENTS	<div>एनटीपीसी NTPC</div>		
	<p>(c.) Class II - Protection co-ordination test for any three ratings of MCC module as selected by employer</p> <p>(d.) Test sequence –1 & combined test sequence on each rating of circuit breaker mounted inside the panel.</p> <p>(e.) Degree of protection tests</p> <p>(f.) Type test certificates for Numerical relays.</p>			



**TECHNICAL SPECIFICATION FOR
HYDROGEN GENERATION PLANT
2 X 800 MW NTPC GADERWARA STPP STAGE-I**

SPEC NO. PE-TS-394-168-A001

VOLUME-IIB

SECTION

REV.NO.0

DATE

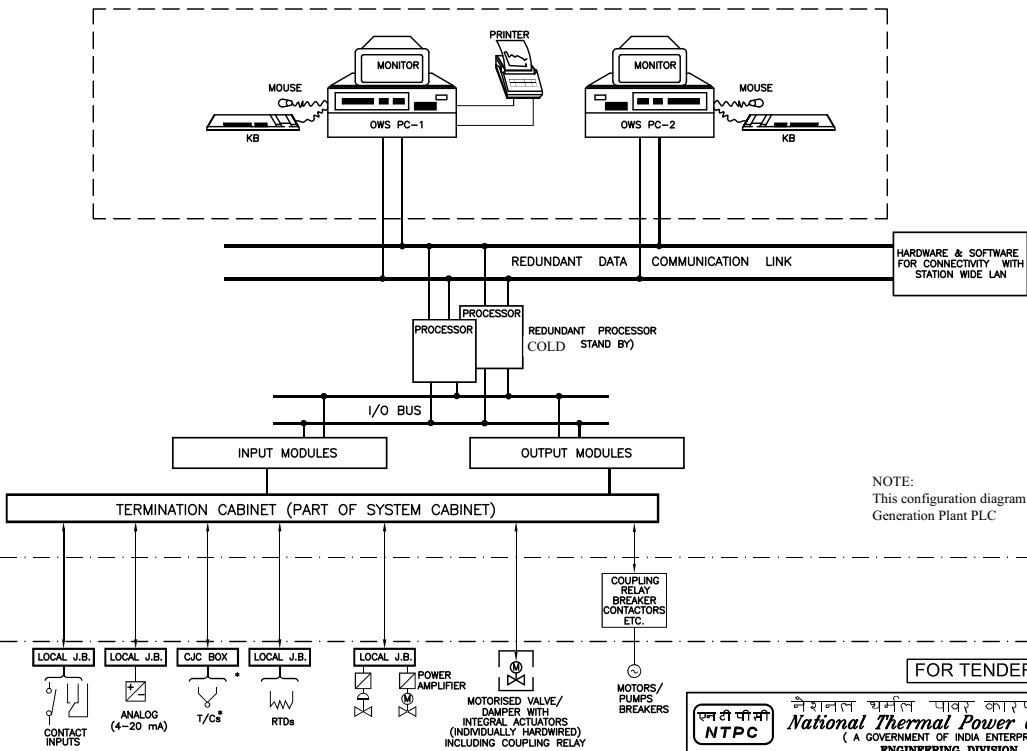
SHEET

**GENERAL TECHNICAL REQUIREMENT FOR
CONTROL & INSTRUMENTATION FOR HYDROGEN
GENERATION PLANT**

	2X800 MW GADARWARA STPP STAGE I	SECTION: C
	SPECIFIC TECHNICAL REQUIREMENTS (C&I) HYDROGEN GENERATION PLANT	
1.0	GENERAL TECHNICAL REQUIREMENTS (C&I)	
1.0	<p>The control of Hydrogen generation plant shall be through dual processor based PLC system. PLC unit shall be provided with two processors (main processing unit with memories), one for normal operation and one as Cold standby. The PLC system shall be provided with necessary interface hardware and software for dual fiber optic connectivity including LIU (Light Interface Unit) at PLC end and interconnection with DDCMIS located at main plant Control Room for monitoring of signal information. The communication protocol shall be OPC compliant. The dual fiber optic communication cable between bidders control panels and BHEL's DDCMIS shall be in bidder's scope. Bidder shall submit PLC system configuration drawing along with functional write-up along with the offer.</p>	
1.1	<p>Two nos. OWS with 21" color TFT monitor along with keyboard & mouse shall be provided by the bidder for operation & monitoring of the entire H2 generation plant. It shall be possible to use the same OWS as programming station. Bidder to provide one number A4 size color laser printer. Complete PLC based control system with OWS, 1x100% UPS (30 Min back up) and 1x100% UPS battery (Ni-Cd) for H2 generation plant shall be in bidder's scope.</p> <p>The PLC panel shall be of Schneider/ SIEMENS/ ROCKWELL AUTOMATION / ABB / GE FANUC/L&T make. The make of the printer shall be HP/ XEROX or equivalent. PC for OWS shall be of workstation grade and shall be of HP/DELL or equivalent make only.</p>	
1.2	<p>PLC control system shall be time synchronized with Master clock system of the main plant through RS-485/IRIG-B link to ensure uniform time indication throughout the Plant. The required provision shall be made by the bidder at PLC end to achieve the same. The time format shall be finalised by BHEL during detail engineering.</p>	
1.3	<p>The software and hardware for the offered PLC system shall be of latest version and shall be upgradable. Bidder to ensure availability of the spares and service support for the offered PLC system for minimum 10 years after guarantee period.</p>	

	2X800 MW GADARWARA STPP STAGE I	SECTION: C
	SPECIFIC TECHNICAL REQUIREMENTS (C&I) HYDROGEN GENERATION PLANT	
1.4	<p>All necessary instruments such as transmitters/temperature elements/sensors/switches/gauges etc. shall be provided for safe, efficient, reliable operation and maintenance of the H₂ generation plant. All instrument devices shall be provided with explosion proof enclosure as described in NEC (USA) Article 500, Class-I, Div. I or provided with suitable type Zener barriers of standard approved make meeting the requirements as approved by the Chief Controller of Explosives, India and statutory authorities.</p>	
1.5	<p>The quantity of instruments shall be as per tender P&ID and Design Memorandum/Philosophy as a minimum, for bidding purpose. However, bidder shall also include in his proposal all the instruments and devices, which are needed for completeness of system/equipment, supplied by the bidder, even if the same is not specifically appearing in the P&ID and Design philosophy. During detail engineering, if any such additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.</p>	
1.6	<p>All the instrumentation equipments and accessories under this specification shall be furnished as per technical specification and ranges, makes/numbers as approved by the owner during detail engineering.</p>	
1.7	<p>The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of the local instruments shall be furnished, even if not specifically asked for, on as required basis. The instrument fittings shall be of forged SS. Instrument piping shall be designed for maximum design pressure & temperature of the process. Pressure instrument connection shall be ½" or 12 mm pipe connection. The contacts of equipment mounted instruments, sensors, switches etc. for external connection including spare contacts shall be wired out to the LCP.</p>	
1.8	<p>All electrical actuators shall be of integral starter type.</p>	
1.9	<p>Following documents to be furnished by the bidder along with the bid:</p> <ul style="list-style-type: none"> • PLC configuration diagram. • Duly stamped and signed copy of Quality Plans. • Requirement of electronic earthing, if any, for PLC based control system. 	

	2X800 MW GADARWARA STPP STAGE I	SECTION: C
	SPECIFIC TECHNICAL REQUIREMENTS (C&I) HYDROGEN GENERATION PLANT	
1.10	<p>Drawings/Documents and data to be furnished after award of the contract:</p> <ul style="list-style-type: none"> • Input/Output signal list. • BOM of PLC. • Control panel/control desk/charger panel/battery GA drawings. • Power distribution scheme. • PLC control room layout drawing. • PLC and field instruments quality plan. • PLC data sheet. • Cable schedule and cable interconnection drawing. • Instrument Schedule. • Instrument Data sheets. • Any other document decided during detailed engineering. 	
1.11	<p>Industrial grade furniture chairs (2 nos.), keypad (1 no.), Locker set (1 no.) etc. shall be in bidders scope. Revolving chairs with wheels and with provision for adjustments of height(hydraulically/gas lift) shall be provided for the operators in local Control Room area. Chair pedestal shall be made of 5mm thick MS plate covered with poly-propylene cladding. Arm-rests in one piece shall be of poly-urethane and twin wheel castor of glass filled nylon. The exact details shall be finalized & approved by owner/purchaser during detailed engineering.</p> <p>All furniture shall be from reputed suppliers like Rittal / Godrej / Pyrotech or equivalent as approved by owner/purchaser.</p>	

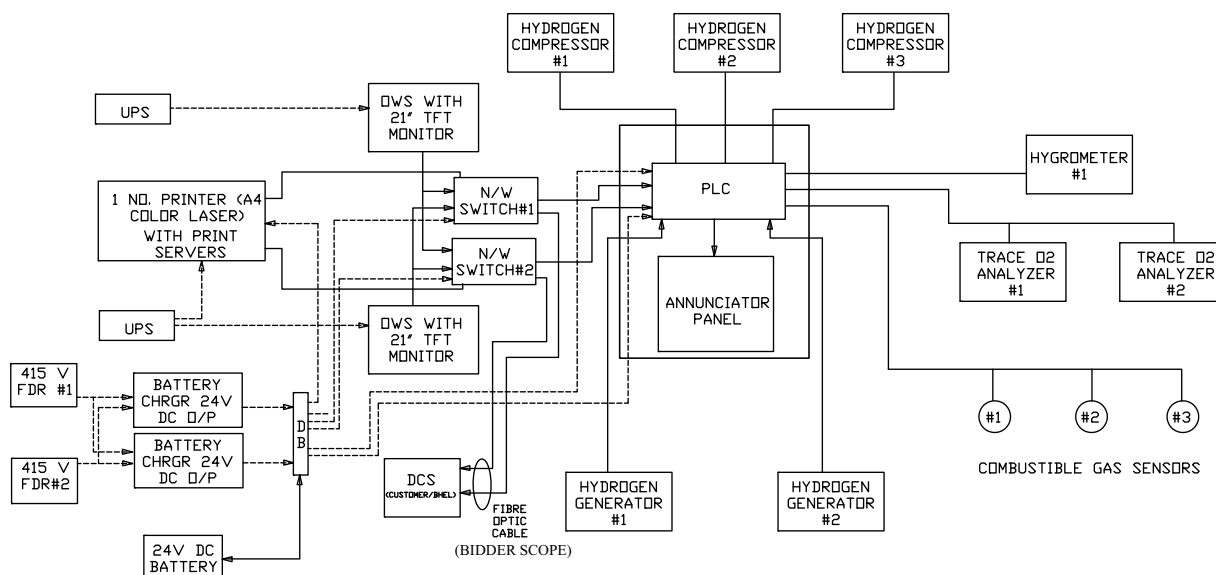


NOTE:
This configuration diagram is applicable only for H2
Generation Plant PLC

FOR TENDER PURPOSE ONLY

													SUBMITTING SYSTEM			
C	GENERALLY REVISED		AR	PS							PS	02.09.03	PROJECT TYPICAL THERMAL POWER PROJECT			
B	GENERALLY REVISED		AR	PS							MPS	16.05.02	TITLE STANDARD CONFIGURATION DIAGRAM FOR PLC BASED OFFSITE CONTROL SYSTEMS			
A	FIRST ISSUE		AR	PS							AKB	16.08.02				
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE	SIZE	SCALE	DRG. NO.		REV. NO.
					CLEARED BY							A3	N.T.S.	0000-999-POI-A-013		C
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STANDARD PLC CONFIGURATION DIAGRAM FOR HYDROGEN GENERATION PLANT



NOTES:

1. POWER TO PLC (IN THE ANNUNCIATOR PANEL) SHALL BE 24 V DC. BATTERY CHARGER AND BATTERY SHALL BE IN BIDDER'S SCOPE..
2. UPS FOR PC AND ITS MONITOR AND PRINTER SHALL BE SMART TYPE LINE INTERACTIVE TYPE WITH SOFTWARE AND HARDWARE ALONGWITH FEATURES OF SURGE SUPPRESSION & AVR FACILITY.
3. SELECTOR SWITCH SHALL BE PROVIDED IN PLC TO SELECT COLD STANDBY PROCESS INTO SERVICE.
4. FURNITURES FOR DWS, PRINTER SHALL BE IN BIDDER'S SCOPE.

	PLANT AUXILIARY SYSTEM
1.00.00	CONTROL AND INSTRUMENTATION FOR HYDROGEN GENERATION PLANT
1.01.00	Contractor shall provide complete Control and Instrumentation system with all accessories, auxiliaries and associated equipments and cables for the safe, efficient and reliable operation of the plant auxiliary systems as indicated under scope part at IIC, Part-A, Section VI.
1.02.00	The quantity of instruments for each plant auxiliary system shall be as per tender P&ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all instruments and devices, which are needed for the completeness of the plant auxiliary system/equipment, supplied by the Contractor, even if the same is not specifically appearing in the P&ID.
1.03.00	All electrical devices like switches/ transmitters/ controller/ analyzer/ solenoid valves which are located in the hydrogen generation plant shall be made intrinsically safe by providing suitable type of transformer isolated barrier/ Zenner barrier of standard make. Otherwise such instruments shall be provided with explosion proof enclosure suitable for hazardous areas described in National Electric Code (USA), Article 500, Class-I, Division-I or EN60079-14 or shall comply with the essential requirements of ATEX directives. All fittings, cable glands etc. shall be strictly as per NEC recommendation article, 500 to 503.
1.04.00	Contractor shall provide PLC control systems for safe, efficient and reliable operation of each of the plant auxiliary systems. The type of control system shall be as indicated under scope part at IIC, Part-A, Section VI.
1.05.00	Control, interlock/ protection, indication of incomers and bus-coupler (even if they are not in the scope of the contractor) are also to be performed from Contractor's Control System for each of the plant auxiliary system as applicable.
1.06.00	It shall be possible to remove/replace online various modules (like any I/O module, interface module, etc.) from its slot for maintenance purpose without switching off power supply to the corresponding rack. System design shall ensure that while doing so, undefined signaling and releases do not occur and controller operation in any way is not affected (including controller trip to manual, etc) except that information related to removed module is not available to controller. Further, it shall also be possible to remove/replace of controller module without switching off the power to the corresponding rack and this will not result in system disturbance or loss of any controller functions for the other controller. The on-line removal/insertion of controller, I/O modules shall in no way jeopardize safety of plant and personnel.
1.07.00	The control system shall provide safe operation under all plant disturbances and on component failure so that under no condition the safety of plant, personnel or

1.08.00	<p>equipment is jeopardized. Control system shall be designed to prevent abnormal swings due to loss of Control System power supply, failure of any Control System component, open circuit/short circuit etc.</p> <p>The Control system shall include on-line self-surveillance, monitoring and diagnostic facility giving the details of the fault on the Human Machine Interface System (HMIS). The faults to be reported shall include fault in main & standby power supplies, sensor fault, Input/ Output card failure, Memory Status, Controller fault, failure of Communication/ Network links to PLCs, LAN etc. These faults shall be reported as colour change on system status display and as messages on HMIS as well as through local indication on the faulty module and on respective rack/ cubicle. The diagnostic system shall ensure that the faults are detected before any significant change in any controller output has taken place.</p>
1.09.00	The Control system shall operate in non-air conditioned area and shall meet the minimum requirements as specified below.
2.00.00	PROGRAMMABLE LOGIC BASED CONTROL SYSTEM
2.01.00	<p>PLC PROCESSOR</p> <p>The processor unit shall be capable of executing the following functions:-</p> <ul style="list-style-type: none"> a Receiving binary and analog signals from the field and providing command output to MCC/SWGR/Drive etc. through Input / Output modules and operator initiated commands from HMIS / control panel. b Implementing all logic functions for control, protection and annunciation of the equipment and systems. c Implementing modulating control function for certain application as specified elsewhere in the specification. d Providing supervisory information for alarm, various types of displays, status information, trending, historical storage of data etc. e Performing self-monitoring and diagnostic functions.
2.02.00	The memory shall be field expandable. The memory capacity shall be sufficient for the complete system operation and have a capability for at least 20% expansion in future. Programmed operating sequences and criteria shall be stored in non volatile semi conductor memories like EPROM. All dynamic memories shall be provided with buffer battery back up which shall be for at least 360 hours. The batteries shall be lithium or Ni-Cd type.

2.03.00	Priority of different commands shall be as follows:
2.03.01	Manual intervention shall be possible at any stage of operation. Protection commands shall have priority over manual commands and manual commands shall prevail over auto commands.
2.03.02	A forcing facility shall be provided for changing the states of inputs and outputs, timers and flags to facilitate fault finding and other testing requirements. It shall be possible to display the signal flow during operation of the program.
2.04.00	HUMAN MACHINE INTERFACE SYSTEM (HMIS)
2.04.01	Operator work station (OWS) shall perform control, monitoring and operation of all auxiliaries/ drives interacting with PLC based control system. It shall be possible to use the same as programming station of the PLC and the Human Machine Interface System. It shall basically perform the following functions. In case the PC based OWS can not be used as programming station of the PLC and the Human Machine Interface System, then separate PC based programming station shall be provided.
2.04.02	Operator shall be able to access all control/information related data under all operating conditions including a single processor/computer failure in the HMIS.
2.04.03	All frequently called important functions including major displays shall be assigned to dedicated function keys on a soft keyboard for the convenience of the operator for quick access to displays & other operator functions.
2.04.04	The operator functions for each OWS shall as a minimum include Control System operation (A/M selection, raise/lower, set point/bias change, on/off, open/close operation, mode/device selection, bypassing criteria, sequence auto, start/stop selection, drive auto selection, local-remote/other multi-position selection etc.); alarm acknowledge; call all kind of displays, logs, summaries, calculation results, etc.; printing of logs & reports; retrieval of historical data; and any other functions required for smooth operation, control & management of information as finalized during detailed engineering.
2.04.05	The display selection process shall be optimized so that the desired display can be selected with the minimum no. of operations. Navigation from one display to any other should be possible efficiently through paging soft keys as well as through targets defined on the displays. There should be no limitation on number of such targets.
2.04.06	The system shall have built-in safety features that will allow/disallow certain functions and entry fields within a function to be under password control to protect against inadvertent and unauthorised use of these functions. Assignment of allowable functions and entry fields shall be on the basis of user profile. The system security shall contain various user levels with specific rights as finalised by the Employer during detailed engineering. However, no. of user levels, no. of users in a

2.05.00	<p>level and rights for each level shall be changeable by the programmer (Administrator).</p> <p>When any drive or sequence is being controlled from one OWS, the system shall inhibit control access of the same drive or sequence from other OWS or Local Control Panel.</p>
2.06.00	<p>PROGRAMMING FUNCTIONALITIES</p> <p>Programming of the PLC Processor / controller as well as programming of HMIS shall be user friendly with graphical user interface and shall not require knowledge of any specialized language. For example, the programming of PLC shall use either of the following:-</p> <ul style="list-style-type: none"> - Flow-chart or block logic representing the instructions graphically. - Ladder diagrams. <p>The programming of HMIS (like development and modification of data base, mimics, logs / reports, HSR functionalities etc.) shall also be possible through user-friendly menus etc</p> <p>All programming functionalities shall be password protected to avoid unauthorized modification.</p>
2.07.00	<p>SOFTWARE REQUIREMENT</p>
2.07.01	<p>All necessary software required for implementation of control logic, operator station displays / logs, storage & retrieval and other functional requirement shall be provided. The programs shall include high level languages as far as possible. The contractor shall provide sufficient documentation and program listing so that it is possible for the Employer to carry out modification at a later date.</p>
2.07.02	<p>The Contractor shall provide all software required by the system for meeting the intent and functional/parametric requirements of the specification.</p>
2.07.03	<p>Industry standard operating system like UNIX/WINDOWS (latest version) etc. to ensure openness and connectivity with other system in industry standard protocols (TCP-IP/ OPC etc.) shall be provided. The system shall have user friendly programming language & graphic user interface.</p>
2.07.04	<p>All system related software including Real Time Operating System, File management software, screen editor, database management software. On line diagnostics/debug software, peripheral drivers software and latest versions of standard PC-based software and latest WINDOWS based packages etc. and any other standard language offered shall be furnished as a minimum.</p>

2.07.05	All application software for PLC system functioning like input scanning, acquisition, conditioning processing, control and communication and software for operator interface of monitors, displays, trends, curves, bar charts etc. Historical storage and retrieval utility, and alarm functions shall be provided.																		
2.07.06	The Contractor shall provide software locks and passwords to Employer's engineers at site for all operating & application software so that Employer's engineers can take backup of these software and are able to do modifications at site.																		
2.08.00	<p>PARAMETRIC REQUIREMENTS</p> <p>The control system shall be designed such that under worst case loading conditions the response time shall not be worst than the following:-</p> <table> <tr> <td>On/Off Command</td><td>- The response time for screen update after the execution of the control command from the time the command is issued (for example command to start a motor to the time the screen is updated) shall be two seconds (excluding the drive actuation time).</td></tr> <tr> <td>Adjustment Command</td><td>- 0.5 to 1 second.</td></tr> <tr> <td>On screen Updating</td><td>- 1 second.</td></tr> <tr> <td>All Control related displays</td><td>- 1 second.</td></tr> <tr> <td>Bar Chart displays</td><td>- 2 to 3 seconds.</td></tr> <tr> <td>Plant Mimic displays</td><td>- 2 to 3 seconds.</td></tr> <tr> <td>Group review displays</td><td>- 2 to 3 seconds.</td></tr> <tr> <td>X-T Plot Displays</td><td>- 1 to 2 seconds.</td></tr> <tr> <td>Plant Summary Displays</td><td>- 1 to 2 seconds.</td></tr> </table> <p>Even under worst case loading condition of HMIS and system Bus, each HMIS processor shall have 50 % spare time when measured over any one minute period and the system bus shall have at least 50 % spare duty cycle.</p>	On/Off Command	- The response time for screen update after the execution of the control command from the time the command is issued (for example command to start a motor to the time the screen is updated) shall be two seconds (excluding the drive actuation time).	Adjustment Command	- 0.5 to 1 second.	On screen Updating	- 1 second.	All Control related displays	- 1 second.	Bar Chart displays	- 2 to 3 seconds.	Plant Mimic displays	- 2 to 3 seconds.	Group review displays	- 2 to 3 seconds.	X-T Plot Displays	- 1 to 2 seconds.	Plant Summary Displays	- 1 to 2 seconds.
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3.00.00	INPUT/OUTPUT MODULES																		
3.01.00	The PLC system should be designed according to the location of the input/output cabinets as specified.																		
3.02.00	Input Output modules, as required in the Control System for all type of field input signals (4-20 mA, RTD, Thermocouple, non change over/change over type of																		
STEAM TURBINE GENERATION PACKAGE																			

	contact inputs etc.) and outputs from the control system (non change over/change over type of contact, 24/48 VDC output signals for energizing interface relays, 4-20 mA output etc.) are to be provided by the Contractor. Contractor to refer drawing nos. 0000-999-POI-A-065 for interface/termination requirements of Field Instruments/Drives.
3.03.00	Electrical isolation of 1.5KV with optical couplers between the plant input/output and controller shall be provided on the I/O cards. The isolation shall ensure that any inadvertent voltage or voltage spikes (as may be encountered in a plant of this nature) shall not damage or mal-operate the internal processing equipment.
3.04.00	The Input/output system shall facilitate modular expansion in fixed stages. The individual input/output cards shall incorporate indications on the module front panels for displaying individual signal status.
3.05.00	Individually fused output circuits with the blower fuse indicator shall be provided. All input/output points shall be provided with status indicator. Input circuits shall be provided with fuses preferably for each input, alternatively suitable combination of inputs shall be done and provided with fuses such that for any fault, fuse failure shall affect the particular drive system only without affecting other systems.
3.06.00	All input/output cards shall have quick disconnect terminations allowing for card replacement without disconnection of external wiring and without switching of power supply.
3.07.00	The Contractor shall provide the following monitoring features: <ul style="list-style-type: none"> a Power supply monitoring. b Contact bounce filtering. c Optical isolation between input and output signals with the internal circuits d In case of power supply failure or hardware fault, the critical outputs shall be automatically switched to the fail-safe mode. The fail-safe mode shall be intimated to the successful Contractor during detailed engineering.
3.08.00	Binary Output modules shall be rated to switch ON/OFF coupling relays of approx. 3 VA at 24 VDC. Analog output modules shall be able to drive an load impedance of 500 Ohms minimum.
3.09.00	Output module shall be capable of switching ON/OFF inductive loads like solenoid valves, auxiliary relays etc. without any extra hardware.
3.10.00	Only one changeover contact shall be provided in MCC for control and interlock requirement. Further multiplication, if required, shall be done by the contractor in PLC system.

3.11.00	All input field interrogation voltage shall be 24V DC or 48 V DC.												
3.12.00	In case of loss of I/O communication link with the main processing unit, the I/O shall be able to go to predetermined fail safe mode (to be decided during detailed engineering) with proper annunciation.												
3.13.00	Wiring Scheme for inputs to control system shall be as follows:												
3.13.01	Each of the triple redundant binary & analog inputs shall be wired to separate input modules. Similarly each of the dual redundant binary & analog inputs shall be wired to separate input modules. These redundant modules shall be placed in different racks, which will have separately fused power supply distribution. Implementation of multiple measurement schemes of these inputs will be performed in the redundant hardware. Loss of one input module shall not affect the signal to other modules. Other channels of these modules can be used by other inputs of the same functional group.												
3.13.02	The single (i.e. non-redundant) binary & analog signal required for control purposes shall be wired as follows:												
3.13.03	All single analog & binary inputs including the limit switches of valves/dampers MCC/SWGR check-backs of all drives & information related signals shall be wired to single (i.e. non-redundant) input modules.												
3.13.04	The on-off status of HT drives etc, however, be wired to two input modules in parallel.												
3.14.00	Inputs and Outputs related to each of the redundant drives / equipments (eg. each of the 3x50 % drives, each of the storage vessel/sump/tank storing same fluid, each of the streams and its related drives etc.) shall be wired to separate input and output modules.												
3.15.00	<p>The signal conditioning functions like multiple measurement schemes, square root extraction for flow signals, pressure and temperature compensation, limit value computation can be performed either in the controllers or in signal conditioning and processing hardware outside controllers.</p> <p>The maximum number of inputs/outputs to be connected to each type of module shall be as follows:</p> <table><tr><td>1.</td><td>Analog input module</td><td>16</td></tr><tr><td>2.</td><td>Analog output module</td><td>16</td></tr><tr><td>3.</td><td>Binary input module</td><td>32</td></tr><tr><td>4.</td><td>Binary output module</td><td>32</td></tr></table>	1.	Analog input module	16	2.	Analog output module	16	3.	Binary input module	32	4.	Binary output module	32
1.	Analog input module	16											
2.	Analog output module	16											
3.	Binary input module	32											
4.	Binary output module	32											

	<p>5. Analog input & output (combined) 16</p> <p>6. Binary input and output (combined) 32</p>
3.16.00	Any single sensor/transducer/transmitter failure alarm shall be provided on programmer station screens for all sensors/transducers/transmitters. Similarly sensor break alarm for thermocouples etc. shall also be displayed on the screens.
3.17.00	Contractor shall provide remote Input/Output modules Housed in free-standing cabinets/racks (with suitable redundant data link to the central PLC system) as specified. These Input/Output modules shall meet the technical requirements as mentioned in the above clauses. Further these Input/Output modules shall be designed to continuously work under the environment expected to be encountered in assigned areas without any air-conditioning support. Wherever the cable route distance of these I/O cabinets/racks exceeds a distance of 300 meters from the Central PLC, fiber optic data link has to be provided.
4.00.00	SYSTEM SPARE CAPACITY
4.01.00	Over and above the equipment and accessories required to meet the fully implemented system as per specification requirements, Control System shall have spare capacity and necessary hardware/ equipment/ accessories to meet following requirement for future expansion at site:
4.02.00	10% spare channels in input/output modules fully wired up to cabinets TB.
4.03.00	Wired-in "usable" space for 20% modules in each of the system cabinets for mounting electronic modules wired up to corresponding spare terminals in system cabinets. Empty slots between individual modules/group of modules, kept for ease in maintenance or for heat dissipation requirement as per standard practice of Contractor shall not be considered as wired-in "usable" space for I/O modules. Terminal assemblies (if any in the offered system), corresponding to the I/O modules shall be provided for above mentioned 20 % blank space.
4.04.00	Each processor / controller shall have 30% spare functional capacity to implement additional function blocks, over and above implemented logic/ loops. Further, each processor / controller shall have spare capacity to handle minimum 30% additional inputs/ outputs of each type including above specified spare requirements, over and above implemented capacity. Each of the corresponding communication controllers shall also have same spare capacity as that of processor/controller.
4.05.00	The Data communication system shall have the capacity to handle the additions mentioned above.
4.06.00	Twenty (20) percent spare relays of each type and rating mounted and wired in cabinets TB. All contacts of relays shall be terminated in terminal blocks of cabinets.

4.07.00	The spare capacity as specified above shall be uniformly distributed throughout all cubicles. The system design shall ensure that above mentioned additions shall not require any additional controller/processor/ peripheral drivers in the system delivered at site. Further, these additions shall not deteriorate the system response time / duty cycle, etc. from those stipulated under this specification.
5.00.00	DATA COMMUNICATION SYSTEM (DCS)
5.01.00	<p>The Communication System shall include a Main System Bus and Other applicable bus systems like cubicle bus, local bus, I/O bus etc.</p> <p>The DCS shall have the following minimum features :</p> <ul style="list-style-type: none"> a Communication controllers shall be provided to handle the communication between I/O Modules (including remote I/O) and PLCs and between PLCs and operator work station/HMI device. b The design shall be such as to minimise interruption of signals. It shall ensure that a single failure anywhere in the media shall cause no more than a single message to be disrupted and that message shall automatically be retransmitted. Any failure or physical removal of any station/module connected to the system bus shall not result in loss of any communication function to and from any other station/module. c Built-in diagnostics shall be provided for easy fault detection. Communication error detection and correction facility (ECC) shall be provided at all levels of communication. Failure of one bus and changeover to the standby system bus shall be automatic and completely bump less and the same shall be suitably alarmed/logged. e The design and installation of the system bus shall take care of the environmental conditions as applicable. f Data transmitting speed shall be sufficient to meet the responses of the system in terms of displays, control etc. plus 25% spare capacity shall be available for future expansion. g Passive coaxial cables or fibre optic cables shall be employed. <p>The Contractor shall furnish details regarding the communication system like communication protocol, bus utilisation calculations etc.</p>
5.02.00	The PLC system shall be provided with necessary hardware and software for dual fibre optic connectivity & interconnection with station wide LAN (In Employer's Scope) for two - way transfer of signals for the purpose of information sharing. The plant information shall be made available through an Ethernet link following TCP/IP standard. The system shall be OPC compliant. The exact data structure shall be as


	decided during detailed engg. All required plant data shall be transferred to/from through this ensuring complete security. The exact number of points to be transferred through the above communication link and the format of the data shall be finalised during detailed engineering. The Contractor shall provide all assistance to the BOP C&I System (In Employer's Scope) Supplier including co-ordination and flow of required information etc. for display of all input points under alarm, connected to PLC or generated by PLC, on various operating stations on BOP C&I System (In Employer's Scope) and various client PCs on station LAN.												
6.00.00	SYSTEM REACTION TIME												
6.01.00	The reaction time of the programmable control system from input signals at the input cards to output of the associated signals or commands of the output card inclusive of programmed logic processing, comprising a mixture of logic gates, arithmetic operations and other internal operations shall be less than 100 milli seconds under the most arduous control system operating conditions.												
7.00.00	OPERATOR INTERFACE DISPLAYS/LOGS/REPORTS												
7.01.00	Suitable Operator Interface Displays/Logs/Reports for control operation & monitoring shall be provided. The details shall be finalized during detailed Engg. stage.												
7.02.00	<p>Minimum quantities shall be as follows:-</p> <div><div>1</div><div>Various displays on the OWS shall as a minimum include P&ID displays or mimic, bar chart displays, X-Y & X-T plot (trend) displays, operator guidance message displays, group displays, plant start-up/shutdown message displays, system status displays etc. Number of displays and the exact functionality shall be on as required basis and as finalised during detailed engineering subject to the minimum quantities as given in subsequent clauses. For X-T & X-Y plots, the facility of providing a background grid on operator request shall be variable with adequate no. of divisions in both co-ordinates.</div></div> <div><div>2</div><div>The minimum quantity of major types of displays per unit shall be as follows:</div><table><tr><td>a)</td><td>Control displays (group/sub-group/sequence/loop)</td><td>(On as reqd. basis subject to 100 minimum)</td></tr><tr><td>b)</td><td>P&ID/ mimic display</td><td>100</td></tr><tr><td>c)</td><td>Bar chart</td><td>30</td></tr><tr><td>d)</td><td>X-T Plot</td><td>30</td></tr></table></div>	a)	Control displays (group/sub-group/sequence/loop)	(On as reqd. basis subject to 100 minimum)	b)	P&ID/ mimic display	100	c)	Bar chart	30	d)	X-T Plot	30
a)	Control displays (group/sub-group/sequence/loop)	(On as reqd. basis subject to 100 minimum)											
b)	P&ID/ mimic display	100											
c)	Bar chart	30											
d)	X-T Plot	30											

	<table><tr><td>e)</td><td>X-Y Plot (with superimposed operating curves + using user selectable stored data)</td><td>25 + 25</td></tr><tr><td>f)</td><td>Group displays</td><td>30</td></tr><tr><td>g)</td><td>Operator guidance message</td><td>10</td></tr><tr><td>h)</td><td>System status & other diagnostic display</td><td>on as required basis</td></tr></table> <p>The assignment for the above will be done by the contractor as per the requirement of operation of Contractor's system as well as for maintenance. The balance displays shall be left as spare for future modification/addition.</p>	e)	X-Y Plot (with superimposed operating curves + using user selectable stored data)	25 + 25	f)	Group displays	30	g)	Operator guidance message	10	h)	System status & other diagnostic display	on as required basis
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f)	Group displays	30											
g)	Operator guidance message	10											
h)	System status & other diagnostic display	on as required basis											
8.00.00	HISTORICAL STORAGE AND RETRIEVAL SYSTEM (HSRS)												
8.01.00	The HSRS shall collect store and process system data from MMIPIS data base. The data shall be saved online on hard disk and automatically transferred to erasable long term storage media once in every 24 hours periodically for long term storage. Provision shall be made to notify the operator when hard disk is certain percentage full. The disk capacity shall be sufficient to store at least seven days data.												
8.02.00	The data to be stored in the above system shall include alarm and event list, periodic plant data, selected logs/reports. The data/information to be stored & frequency of storage and retrieval shall be as finalised during detailed engineering. The system shall provide user-friendly operator functions to retrieve the data from historical storage. It shall be possible to retrieve the selected data on OWS or printer in form of trend/report by specifying date, time & period. Further, suitable index files/directories shall also be provided to facilitate the same. The logs/reports for at least last seven (7) days shall be available on the disk.												
8.03.00	In addition to above, the system shall also have facility to store & retrieve important plant data for a very long duration (plant life) on portable long term storage media). These data will include any data from the database as well as processed/computed data based an various calculations/transformation. The retrieved data from long term storage media should be possible to be presented in form of X-T display, X-Y display, logs, reports, etc.												
9.00.00	CONTROL & POWER SUPPLY SCHEME												
9.01.00	General Requirements <p>Necessary redundant transformers and redundant chargers with 24 V DC battery back-up shall be provided by the Contractor to derive power supply from 415V, 3-phase 3-wire incomers to be arranged by the Contractor at the input terminals of power supply cabinets. The Contractor shall, however furnish all required hardware/</p>												


	<p>equipment/ cubicles for conversion and/or stabilization of the power source provided by the Employer to all other levels which may be necessary for meeting the individual requirements of equipments/ systems furnished by him within the Contractor's quoted lump sum price.</p> <p>The 24 V DC power supply system configuration shall be provided as per Appendix-1, Section VI, Part – A of specifications</p>
10.00.00	CONTROL CABINETS / PANELS
10.01.00	<p>The cabinets shall be IP-22 protection class. The Contractor shall ensure that the packaging density of equipment in these cabinets is not excessive and abnormal temperature rise, above the cabinet temperature during normal operation or air-conditioning failure, is prevented by careful design. This shall be demonstrated to the Employer during the factory testing of the system. The Contractor shall ensure that the temperature rise is limited to 10 deg. C above ambient and is well within the safe limits for system components even under the worst condition as specified in Sub-section-basic Design criteria (Part-B, Section-VI) and specification requirements for remote I/O cabinets. Ventilation blowers shall be furnished as required by the equipment design and shall be sound proof to the maximum feasible extent. If blowers are required for satisfactory system operation, dual blowers with blower failure alarm shall be provided in each cabinet with proper enclosure and details shall be furnished with proposal. Suitable louvers with wire mesh shall be provided on the cabinet.</p>
10.01.01	The cabinets shall be designed for front access to system modules and rear access to wiring and shall be designed for bottom entry of the cables.
10.01.02	The cabinets shall be totally enclosed, free standing type and shall be constructed with minimum 2 mm thick steel plate frame and 1.6 mm thick CRCA steel sheet or as per supplier's standard practice for similar applications, preferred height of the cabinet is 2200 mm. The cabinets shall be equipped with full height front and rear doors. The floor mounting arrangement for other cabinets shall be as required by the Employer and shall be furnished by the Contractor during detailed engineering.
10.01.03	Cabinet doors shall be hinged and shall have turned back edges and additional braking where required ensuring rigidity. Hinges shall be of concealed type. Door latches shall be of three-point type to assure tight closing. Detachable lifting eyes or angles shall be furnished at the top of each separately shipped section and all necessary provisions shall be made to facilitate handling without damage. Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is more than 800 mm, double doors shall be provided.
10.01.04	Two spray coats of inhibitive epoxy primer-surface shall be applied to all exterior and interior surfaces. A minimum of 2 spray coats of final finish colour shall be applied to all surfaces. The final finished thickness of paint film on steel shall not be less than

	<p>65-75 micron for sheet thickness of 2 mm and 50 microns for sheet thickness of 1.6 mm. The finish colors for exterior and interior surfaces shall conform to following shades:</p> <p>(a.) Exterior:- As per RAL 9002 (End panel sides RAL 5012), to be finalized during detailed engineering.</p> <p>(b.) Interior:- Same as above.</p>
10.01.05	Paint films which show sags, checks or other imperfections shall not be acceptable.
10.01.06	As an alternative, single coat of anodic dipcoat primer along with single textured powder coating with epoxy polyester meeting the thickness requirement is also acceptable.
10.01.07	Refer Subsection Basic Design Criteria, Part B, and Section VI for grounding requirements.
10.01.08	The mimic shall be configured on the OWS and it shall be possible to control, monitor and operate the plant from the same.
10.01.09	The technical specification covering panel fabrication details, wiring and termination details etc. shall be as described under Sub-Section INST CABLE of this specification.
11.00.00	ANNUNCIATION SYSTEM
11.01.00	Only OWS based alarm system shall be provided with audio alarm facility (beep/tone generator). No facia annunciation is envisaged in the control room. Hooters are to be provided.
11.02.00	The system shall display history of alarms in chronological order on any of the OWS. The HMIS shall have the capability to store a minimum of 500 alarms each with paging features allowing the operator to view any page. The system shall have all alarm functions and related function keys like alarm acknowledge, reset, paging, summaries etc. Other design features like set point/dead band adjustments, provision of alarm priority, manual inhibition & automatic inhibition based on predefined logic etc., shall be provided and shall be as finalised during detailed engineering. The alarm display/report format shall be as approved by the Employer.
11.03.00	Facility of audio annunciation shall be provided in OWS upon the occurrence OWS alarms irrespective of whether alarms are displayed or not. Facility to disable the audio annunciation shall be provided.
11.04.00	At least three levels of alarm priority shall be available which will be displayed in different colour. It shall be possible to display & print alarms of any of the three levels.

11.05.00	The annunciator sequence shall conform to ISA sequence ISA-2A..														
12.00.00	SOFTWARE DOCUMENTATION AND SOFTWARE LISTINGS														
12.01.00	All technical manuals, reference manuals, user's guide etc., in English required for modification/editing/addition/deletion of features in the software of the PLC System shall be furnished. The Contractor shall furnish a comprehensive list of all system/application software documentation after system finalization for Employer's review and approval.														
12.02.00	All The software listings including Source code for application software, All special - to-project data files etc. shall be submitted by the Contractor.														
13.00.00	SOFTWARE LICENCES The Contractor shall provide software license for all software being used in Contractor's System. The software licenses shall be provided for the project (e.g. organisation or site license) and shall not be hardware/machine-specific. That is, if any hardware/machine is upgraded or changed, the same license shall hold good and it shall not be necessary for Employer to seek a new license/renew license due to upgradation/change of hardware/machine in Contractor's System at site. All licenses shall be valid for the continuous service life of the plant. As a customer support, the Contractor shall periodically inform the designated officer of the Employer about the software upgrades/new releases that would be taking place after the system is commissioned so that if required, same can be procured & implemented at site.														
14.00.00	(A) SPECIFICATIONS OF OWS <table border="1"> <tr> <td colspan="2">The minimum requirement for PC based OWS shall be as below:</td></tr> <tr> <td>CPU</td><td>Latest generation CPU</td></tr> <tr> <td>Main memory</td><td>1 GB expandable to 4 GB</td></tr> <tr> <td>Drives</td><td>3 1/2" floppy drive, 48 x CD ROM drive</td></tr> <tr> <td>Hard disk</td><td>80 GB</td></tr> <tr> <td>Removable bulk storage drive (MOD / DVD / DAT)</td><td>8 GB (minimum)</td></tr> <tr> <td>Removable Bulk Storage Media for above</td><td>10 nos</td></tr> </table>	The minimum requirement for PC based OWS shall be as below:		CPU	Latest generation CPU	Main memory	1 GB expandable to 4 GB	Drives	3 1/2" floppy drive, 48 x CD ROM drive	Hard disk	80 GB	Removable bulk storage drive (MOD / DVD / DAT)	8 GB (minimum)	Removable Bulk Storage Media for above	10 nos
The minimum requirement for PC based OWS shall be as below:															
CPU	Latest generation CPU														
Main memory	1 GB expandable to 4 GB														
Drives	3 1/2" floppy drive, 48 x CD ROM drive														
Hard disk	80 GB														
Removable bulk storage drive (MOD / DVD / DAT)	8 GB (minimum)														
Removable Bulk Storage Media for above	10 nos														


CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.01.10	6	Keys	Function keys and numeric keys	
	7	Interfacing requirements	Interface with respective control systems	
	8	Functional requirements	Ability to operate drives locally using function keys. Ability to do programming. Graphics display including alarms and operator guidance messages.	
	Printers			
	Sr. No	Features	Colour Laser Printer	Colour Laser Printer
	1	Paper Size	A3	A4
	2	Printing Speed (min.)- in normal mode for A4 size paper	6 ppm (Color)	4 ppm (color)
			24 ppm (B&W)	16 ppm (B&W)
	3	Type	Heavy duty, at least 50000 pages/month	Heavy duty, at least 30000 pages/month
	4	Resolution (black) (min.)	600 dpi	600 dpi
	5	First page out time (with full graphic display)	=<1 min for color,	=<1 min for color,
			<45 sec for BW	<45 sec for BW
	6	Paper input capacity (min.)	500 sheets	500 sheets
	7	Additional features	Automatic Duplex Printing	
	8	Paper sheets	20 reams (A3)	20 reams (A4)

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>
		(1 ream = 500 sheets) with each printer	20 reams (A4)	
	9	Additional Cartridge/toner/ ribbon of each type as used in printer with each printer	1	1
1.01.11	Specification of PC/Lap TOP The Specification of PC/LAP TOP shall be as per the specific requirement of application and shall be as per OEM recommendation			
1.01.12	NOT USED			
1.01.13	NOT USED			
1.01.14	Firewall : Firewall appliance should facilitate multi-vendor, multi-application environment and should support third-party products on open alliance. It should support Active-Active configuration. <div><div></div> The firewall should contain following features: <div>(a) Stateful inspection of packets. (b) NAT functionality, including dynamic and static NAT translations (c) Latest version of SNMP</div></div> <div><div></div> The firewall must send log information to a separate log server via an encrypted connection. Firewall logging must not impact firewall performance.</div> <div><div></div> Remote network access to the firewall should only be possible through the administration interface.</div> <div><div></div> The firewall administration station must be capable of pushing firewall security policies and configurations to individual or multiple firewalls through a secure, encrypted connection to the firewall administration interfaces.</div> <div><div></div> Graphical User Interface (GUI) and a Command Line Interface (CLI) for making changes to the firewall rules set should be provided. (Access to the</div>			


CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
9.00.00	CONTROL AND INSTRUMENTATION FOR PLANT AUXILIARY SYSTEMS			
9.01.00	Instrumentation and Control System with interlocks, protection and annunciation of the mechanical common auxiliary systems as mentioned below shall be provided. Instrumentation for this system shall meet the requirement stipulated under Sub-section Aux. Plant. Ctrl, Part -B, Section-VI of Technical Specification. All necessary equipments / system for control, monitoring and operations of the plants as well as the incomers and bus couplers shall be provided.			
9.02.00	For certain plants, control systems shall be provided as indicated below:			
	SI No	Auxiliary Plant	Control System	HMIPIIS etc.
	01	Hydrogen Plant	Independent Microprocessor based / PLC based control system as per vendor's standard practice with redundant cold standby processor.(Refer relevant Tender Drawing for the configuration)	Microprocessor based / PLC based with Two number Operator Workstations cum programming station, one number A4 size Color Laser printer. Dual two way Ethernet Connectivity utilising OPC to employer Station LAN for information.
	02	Lub oil purification system(Main Turbine and Central Lub oil purification system)	Local control panel for local operation and interface to TG control system controls	
10.00.00	TYPE TEST REQUIREMENT			
10.01.00	The type tests to be conducted for C&I systems & equipments shall be as detailed out in Sub-Section C&I TYPE TEST, Part-B, Section-VI of Technical Specification.			


CLAUSE NO.	SCOPE OF SUPPLY & SERVICES				
11.00.00	OTHER INTERFACING REQUIREMENT TO/FROM EMPLOYERS PROCURED CONTROL AND INSTRUMENTATION SYSTEM				
	SI No	Employer procured system	Brief Description of the system	Interfacing Requirement	Specific requirements
	01	PLANT PERFORMANCE ANALYSIS, DIAGNOSIS & OPTIMIZATION SOFTWARE	<p>A PC based On-line Plant Performance Analysis, Diagnosis & Optimization system (PADO) for the station is being procured by Employer in a separate package which will carry out the following functions as detailed below. The PADO system shall provide the following functions in a modular and seamlessly integrated environment, using a common plant model and a dynamically shared database</p> <ul style="list-style-type: none"> • Performance analysis and monitoring of systems and components. • Emission Analysis and monitoring. • System and performance diagnosis. • System and performance optimization. • Boiler 	<p>The Contractor shall be required to furnish all the P&ID's in his scope ,Heat Balance diagrams, Heat Rate correction curves, Data sheets of equipments e.g Heaters, Condenser, Pumps, Generator etc.. for proper development and improvements of PADO.</p> <ul style="list-style-type: none"> • The system shall use the measured data from the Bidder's DDCMIS through appropriate interface to be provided by the bidder 	<p>The no of analog signals and Binary signals required from contractor supplied DDCMIS system are approximately 250 Analog (including calculated) and 50 Binary signals. How-ever any other signal if required during detailed engineering shall also be supplied on as required basis. The individual signal data transfer rate shall not exceed 1 minute .</p>

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES				
			<p>performance optimizations including optimized operation of soot Blowing system.</p> <ul style="list-style-type: none"> Boiler stress condition analysers. Interactive water and gas chemistry management system. Regenerative cycle performance optimization system. 	<p>through employers procured station LAN/ Unit LAN</p>	
	02	TG-Soft link to employer DDCMIS	<p>(a) Redundant signal exchange to employer HMIPIS utilizing Ethernet/ OPC based communication system for Alarms, analysis softwares, Logs, MIMICS,ERP interfaces</p> <p>(b) LVS annunciation system</p>	<p>Redundant Ethernet based OPC link</p>	<p>(a) All Analog signal transfer at 1 second except for temperature points ,which shall be as per the process update rate.</p> <p>(b) All drives status</p> <p>(c) In case LVS based annunciation are not offered by the Bidder, then all the time stamped alarms and critical DDCMIS diagnostics events generated in</p>

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES				
					 Bidder's DDCMIS system shall be transferred to Employer's DDCMIS system utilizing OPC communication links.
	03	SOE system	Integrated SOE is being procured by the employer	Potential free Signals contacts from the Bidders supplied DDCMIS system	Quantity of SOE signal shall be approximately 100 Nos How-ever these are the minimum quantities to be considered. Bidder to supply the same as on required basis.
	04	HART instruments /Device Connectivity	HART management System is Employer's Scope	Terminations for connecting instruments/Device to connect with employer's procured HART Management System.	In case online programming by employer procured HART management system is not allowed for the instruments/devices, that are being offered as a part of standard and proven instrumentation for STG integral controls and TDBFP integral Controls, the transmitter's/DDCMIS system would be provided with the necessary capability to be interfaced with the employer procured HART Management


CLAUSE NO.	SCOPE OF SUPPLY & SERVICES				<div>एनडीपीसी NTPC</div>
					system after the system is handed over to the employer.
	05	H/W signal exchange for employer procured control system	Open Loop Control system, Closed loop Control system (CMC etc), Protection system (such as RH protection) are being implemented in a employer procured control system	All the standard hardwired signals to/from the bidder's /employer control system required for implementing the control and protection strategies shall be provided	<p>For quantity estimation of these signal following minimum quantities/types to be considered.</p> <p>30-AO 5-AI 50- DI 75-DO</p> <p>How-ever these are the minimum quantities to be considered.</p> <p>Bidder to supply the same on as required basis.</p>
12.00.00	OTHER SCOPE OF ENGG SERVICES				
12.01.00	All control ,monitoring and operations of all equipments/systems that are defined under "Terminal Point and exclusions" chapter in Part-A of this specification are being controlled through microprocessor based Distributed Digital Control Monitoring and Information System (DDCMIS) being procured by Employer under separate package (Station C&I Package). This DDCMIS system shall perform all functions such as auto / manual operation of valves, pumps, drives, local / remote selection of operation, status indication, annunciation, interlock and protection of pumps/drives etc.				
12.02.00	For successful implementation of the same, the Contractor shall furnish all the required details/drawings/data/information like list of drives to be controlled, write-ups for controls, interlock and protection of Contractor's equipment, recommended control loops, External connection diagrams or any other data etc as might be required by Employer during detailed Engineering stage without any cost repercussion.				


CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	
12.03.00	The logics diagram for the above shall also be provided by the bidder to the employer, for implementing the control schemes in employer's procured control system.	
12.04.00	The Bidder shall provide the comprehensive engineering documents such as IO list, Drive list, instrument schedule, JB grouping document etc in the reusable MS Excel format. The typical formats for these are also enclosed with this specification. These documents are required for all the instruments/drives/signals that are covered in this scope of work.	
12.05.00	NOT USED	
12.06.00	The Contractor's representative shall be present at the time of Factory Acceptance test of the above mentioned Control System being procured by Employer at finally selected Employer Vendor's works.	
12.07.00	Contractor shall provide all necessary supervision/assistance for proper commissioning of his equipment to Control System Supplier through Employer.	
12.08.00	The Contractor shall provide KKS codes for all instruments and drives in the scope of work. The list of kks codes to be adopted by the bidder are also being provided along with this specification.	
13.00.00	TOOLS & TACKLES	
13.01.00	The Contractor shall furnish a complete new set of all special tools and tackles of reputed make and model which are required for erection, ease in maintenance to have minimum down time, testing and calibration of all the equipments and systems to be provided by the Contractor under this specification for C&I systems.	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES
	<div style="text-align: right;">  </div> <p>a. BFP Drive Turbine-A block: This block will consist of BFP Drive Turbine-A OLCS and CLCS controls, including EHTC of Drive Turbine-A and Auxiliaries of Drive Turbine-A.</p> <p>b. BFP Drive Turbine-B block: This block will consist of BFP Drive Turbine-B OLCS and CLCS controls, including EHTC of Drive Turbine-B and Auxiliaries of Drive Turbine-B.</p> <p>c. Balance control implementation :- The remaining controls envisaged in the scope of the work such as HP/LP bypass system, condenser on load tube cleaning system, SCS, CPU Controls, Turbine lube oil purification control, central lub oil purification control etc. can be implemented in any of the above process blocks or separately as per the Bidder's standard and proven practice. The exact implementation methodology ,how-ever shall be strictly as approved by Employer during detailed engineering.</p> <p>d. If it is a standard and proven practice of the bidder to offer proprietary integral controls for the systems/equipments listed at a) b) and c) ,the same shall also be acceptable how-ever these systems shall be interfaced suitably with the offered DDCMIS system so as to realize a unified HMIPIS for plant, operation monitoring and controls. For each such proprietary control suitable programming kit/device/station shall also be supplied. The exact interfacing details shall be as finalised during detailed engineering and subject to employer approval.</p> <p>3.02.00 Input/output signal multiplication, and distribution of process, system and software generate points, etc. required within the system are to be provided by the Contractor on as required basis.</p> <p>3.03.00 For signal exchange with BOP C&I systems, Contractor shall provide suitable data link/interface as specified in item Signal Exchange, Subsection DDCMIS, Part B, Section VI. of the specification. The no of such signals shall be as identified under Section-VI, Part-A .However signals required to be exchanged between SG/BOP C&I systems for protection of Turbine, Boiler and other HT drives as well as for CMC shall be hardwired. The same shall be provided on as required basis.</p> <p>3.04.00 The spare capacity for the system as indicated under item System Spare capacity, Subsection DDCMIS, Part B, Section VI shall be included and provided by the Contractor.</p> <p>3.05.00 The contact rating of "DO (contact)" type outputs from control system shall be as follows. The contact rating for such outputs for Unit DDCMIS shall be minimum 60VA, and shall be suitable for contact interrogation at 24 V DC. For such outputs</p>

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES																													
	<div>एनटीपीसी NTPC</div> <p>for other DDCMIS systems relays shall be provided for each of such outputs, and the rating of contacts of the relays shall be as specified in Part-B of specification.</p> <p>4.00.00 The following back-up instrumentation and Secondary instruments shall be provided by the Employer as a minimum for TG applications. Contractor has to supply all the required input output modules in TG C&I part of DDCMIS for interface of these modules without any cost implication to the employer. The quantity indicated here is for each unit.</p> <table><tr><td>(i)</td><td>2 PB + 3 LED</td><td>5</td></tr><tr><td>(ii)</td><td>TRIP PB</td><td>1</td></tr><tr><td>(iii)</td><td>RECESSED PB(Release)</td><td>1</td></tr></table> <p>5.00.00 NOT USED</p> <p>6.00.00 LIST OF AREAS FOR WHICH SOFT SIGNALS IS TO BE CONNECTED TO STEAM TURBINE AND GENERATOR (STG) C&I SYSTEM</p> <table><tr><th>SI No.</th><th>Area</th><th>Connected to the DDCMIS System</th><th>Minimum Qty of links/ Location</th><th>Type</th><th>Qty of signals</th></tr><tr><td>1.</td><td>TG Charger in each unit</td><td>TG C&I of respective unit</td><td>04 Nos. / Charger Room per unit</td><td>RS 485 / RS232</td><td>40 per charger</td></tr></table> <p>7.00.00 PLC BASED CONTROL SYSTEMS</p> <table><tr><th>SI No.</th><th>Area</th><th>Description of Control system</th><th>Quatity</th></tr><tr><td>1.</td><td>Hydrogen Generation Plant</td><td>Microprocessor/PLC based Control system as per manufacturer's standard practice with redundant cold stand-by processor.</td><td>I Set (as per the configuration drawing)</td></tr></table>	(i)	2 PB + 3 LED	5	(ii)	TRIP PB	1	(iii)	RECESSED PB(Release)	1	SI No.	Area	Connected to the DDCMIS System	Minimum Qty of links/ Location	Type	Qty of signals	1.	TG Charger in each unit	TG C&I of respective unit	04 Nos. / Charger Room per unit	RS 485 / RS232	40 per charger	SI No.	Area	Description of Control system	Quatity	1.	Hydrogen Generation Plant	Microprocessor/PLC based Control system as per manufacturer's standard practice with redundant cold stand-by processor.	I Set (as per the configuration drawing)
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1.	Hydrogen Generation Plant	Microprocessor/PLC based Control system as per manufacturer's standard practice with redundant cold stand-by processor.	I Set (as per the configuration drawing)																											


CLAUSE NO.	SCOPE OF SUPPLY & SERVICES				
8.00.00	THE QUANTITIES OF OTHER EQUIPMENT RELATED TO CONTROL SYSTEM, HMI/PS ETC IS AS FOLLOWS.				
	Sl. No.	Item Name	Unit	DDCMIS	Remarks
	1.0	Control System		Qty./Unit	
	1.1	Functional groups	Nos.	As per the guidelines indicated in Appendix-1 to C&I contract quantities part-A.	
	1.2	Control Cabinets for housing Control system hardware	Nos.	On as required basis	
	1.3	(a) Control Cabinets for housing Remote I/O's hardware for Service vessel/unit and CPU Regeneration system. (b)Control Cabinets for housing Remote I/O hardware (wherever specified/applicable)	Nos.	On as required basis On as required basis	
	1.4	Marshalling Cabinets, Termination cabinets, Relay Cabinets	Nos.	On as required basis as per the applicability of these cabinets in line with specification requirement	
	1.5	Relays	Nos.	On as required basis	
	1.6	Cubicles for mounting network components & power supply distribution equipment	Nos.	On as required basis	
	2.0	Human Machine Interface			

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES					
	2.1	Redundant Servers (Only for Alternative 1)	Sets	1	1 set is Two Nos. servers minimum.	
	2.2	Operator Work Stations	Nos.	2	The function of OWS can be implemented in the server itself for Alternate-1	
	2.3	Programming station	Nos.	1	If system documentation facility is not part of this station, separate workstations shall be provided for the same.	
	2.4	Information Work Stations (only for Alternative-II)	Nos.	2	The function of information Workstations can be merged with each of the OWS.	
	2.5	Large Video Screens(LVS)	Nos.	Nil	Screens are being procured by Employer under Station C&I package	
	2.6	Work Station for LVS	Nos.	2		
	2.7	Suitable redundant interfaces and redundant links for connectivity between Unit LAN/ station wide LAN, and DDCMIS sub systems, unit/station PLCs, PC stations, PADO, Remote Service Centre as applicable.	Sets	1	Each set will include components for respective remote I/O & FGs.	


CLAUSE NO.	SCOPE OF SUPPLY & SERVICES				
9.00.00	2.8	Control System Programming device including EPROM Writer/eraser etc. (if applicable)	Nos.	2	This item is not required in case not applicable.
	2.9	Data Communication System		As required basis	
	2.10	Remote Service centre hardware		As required basis	
	3.0	Printers			
	3.1	NOT USED			
	3.2	Laser jet colour printer (A4 size)	Nos.	1	
	4.0	Software			
		Software for DDCMIS meeting requirements specified under item "SYSTEM SOFTWARE REQUIREMENTS", sub section DDCMIS, Part-B, Section-VI of Technical Specifications.		As required basis	
10.00.00	24 V DC POWER SUPPLY SYSTEM 24 V DC Power Supply systems shall be of continuous duty for the following estimated loads:-				

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES						<div>एनडीपीसी NTPC</div>	
	Description of Loads	Contractor's load	Power supply Configuration	Employer's load	Total Rating (Amp)	Quantity		
						per unit	Common	
	1. UNIT TG C&I :- 24 V DC for all Contractor's load including a. TG-C&I system (see notes below); b. Any other load of Contract or supplied system/equipment requiring 24 V DC supply	*	1. As per cl 1.03.00(A), Subsection-IIIC-05			2 sets		
	2. Hydrogen Generation Plant (see notes below)		2. As per cl 1.03.00(D), Subsection-IIIC-05				1 set	
	3. CPU Remote I/O panels(For common Regeneration area)	*	3. As per cl 1.03.00(B), Subsection-IIIC-05				2 sets	
The rating marked “*” are for instrument/equipment/system being supplied by Contractor. The Bidder shall estimate the requirement of these and provide additional capacity margin of 5% of the estimated Contractor's load for all the								

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES																																								
	<div><div>एनटीपीसी NTPC</div></div> <p>items and thereafter add the Employer's loads to get the load for the entire system.</p> <p>Note:-</p> <div><div>1.</div><div>Control system would cover as a minimum, controllers, I/Os, associated modules etc. as well as, data communication system & Network devices (like LAN Switches), related to control system associated relays and solenoid valves driven by 24 V DC system, etc;. Any other loads of Contractor requiring 24 V DC supply shall also be included in this calculation.</div></div> <div><div>2.</div><div>One set of manual discharge resistance bank of adequate capacity shall be Provided Per unit for the main plant 24VDC TG(C&I) control system.</div></div>																																								
11.00.00	UPS																																								
11.01.00	Uninterrupted Power Supply of required capacity shall be provided by Contractor for HMI and other relevant equipment of Hydrogen Generation Plant and CPU System																																								
11.02.00	<p>Employer shall provide following single phase, 230 V AC UPS feeders for powering various Main Plant TG loads under the scope of this work through PDBs with redundant inputs from both ACDBs. Further distribution from ACDB downwards including the PDB's shall be in the scope of Bidder.</p> <table><tr><th>Sl. no</th><th>Fdr no.</th><th>Frm</th><th>To</th><th>Feeder Desc.</th><th>KVA</th><th>PDB location</th><th>PDB scope</th></tr><tr><td>1</td><td>Fdr-1</td><td>ACDB-1</td><td>PDB-110-1</td><td>HMI Load-1</td><td>6</td><td>Prog. Room</td><td>TG vendor</td></tr><tr><td>2</td><td>Fdr-2</td><td>ACDB-1</td><td>PDB-110-1</td><td>HMI Load-2</td><td>6</td><td>Prog. Room</td><td>TG vendor</td></tr><tr><td>3</td><td>Fdr-3</td><td>ACDB-1</td><td>PDB-110-2</td><td>TSI & other Loads</td><td>3</td><td>CER</td><td>TG vendor</td></tr><tr><td>4</td><td>Fdr-4</td><td>ACDB-1</td><td>PDB-110-3</td><td>Miscellaneous Loads</td><td>5</td><td>8.5m</td><td>TG vendor</td></tr></table> <p>Notes:</p> <div><div>(1)</div><div>Feeders from ACDB-1 are only indicated above. Identical feeders for each PDB shall be provided from ACDB-2.</div></div>	Sl. no	Fdr no.	Frm	To	Feeder Desc.	KVA	PDB location	PDB scope	1	Fdr-1	ACDB-1	PDB-110-1	HMI Load-1	6	Prog. Room	TG vendor	2	Fdr-2	ACDB-1	PDB-110-1	HMI Load-2	6	Prog. Room	TG vendor	3	Fdr-3	ACDB-1	PDB-110-2	TSI & other Loads	3	CER	TG vendor	4	Fdr-4	ACDB-1	PDB-110-3	Miscellaneous Loads	5	8.5m	TG vendor
Sl. no	Fdr no.	Frm	To	Feeder Desc.	KVA	PDB location	PDB scope																																		
1	Fdr-1	ACDB-1	PDB-110-1	HMI Load-1	6	Prog. Room	TG vendor																																		
2	Fdr-2	ACDB-1	PDB-110-1	HMI Load-2	6	Prog. Room	TG vendor																																		
3	Fdr-3	ACDB-1	PDB-110-2	TSI & other Loads	3	CER	TG vendor																																		
4	Fdr-4	ACDB-1	PDB-110-3	Miscellaneous Loads	5	8.5m	TG vendor																																		

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES																		
	<div>(2) Above indicated UPS feeders shall be provided from Employer's ACDB.</div> <div>(3) PDBs along with the necessary change over circuits (as applicable) along with further distribution to the load shall be in the scope of the contractor.</div> <div>(4) Half of the HMI Loads are to be powered through Feeder-1 and remaining half through Feeder-2 to ensure availability of at least 50% of the HMI Loads in event of any fault in either of the feeders.</div>																		
12.00.00	PROCESS CONNECTION AND PIPING																		
12.01.00	The Contractor shall provide, install and test all required material which is necessary for proper installation and interconnection of the equipment/systems furnished by the Contractor as per this specification and their integration with Employer's main equipment/systems as per Technical Specification requirements and its sub-clauses, enclosed installation drawings and other applicable clauses on as required basis. The Contractor shall furnish, within his quoted lump sum price, all hardware and accessories to ensure that the equipment/systems furnished against this specification form a complete and operational system meeting the intent and requirement of this specification.																		
12.02.00	The Bidder shall note that no price adjustments shall be applicable for the equipment and services furnished as per this sub-section since the Contractor has to furnish these equipment/services on as required basis.																		
12.03.00	<div>Local Instrument Enclosures (LIEs) and Local Instrument Racks (LIRs)</div> <div>a) Local Instrument Enclosures (LIEs) complete with all fittings, mountings & accessories etc for each unit on as required basis.</div> <div>b) Local Instrument Racks (LIRs) complete with all fittings, mountings & accessories etc. for each unit on as required basis.</div>																		
13.00.00	<div>THE FOLLOWING CONTRACT QUANTITIES OF EQUIPMENTS FOR LOCAL OPERATION SHALL BE FURNISHED FOR THE FOLLOWING SYSTEMS.</div> <table><tr><th>SI No.</th><th>Item Description</th><th colspan="2">Qty</th><th>Application and location</th></tr><tr><td></td><td></td><th>Unit</th><th>Common</th><td></td></tr><tr><td>1.</td><td>Operator Work stations</td><td></td><td>As per PLC configuration</td><td>At Hydrogen Generation Plant Control room</td></tr></table>				SI No.	Item Description	Qty		Application and location			Unit	Common		1.	Operator Work stations		As per PLC configuration	At Hydrogen Generation Plant Control room
SI No.	Item Description	Qty		Application and location															
		Unit	Common																
1.	Operator Work stations		As per PLC configuration	At Hydrogen Generation Plant Control room															

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES					
14.00.00 15.00.00				drawing		
	2.	Operator Work stations	1 No	CPU regeneration control room	Operator Work stations	
	3.	Graphical Interface unit of 10"	1 no/unit plus +2 nos for common regeneration area	CPU service vessel remote I/O room+ CPU regeneration local control area	Graphical Interface unit of 10"	
	ONE SET OF RELATED FURNITURE, AS DEFINED BELOW :					
	SI No.	Area	Item description		Qty (unit)	Qty (Common)
	1.	Hydrogen Generation Plant	a. Chair			2 nos
			b. Key pad			1 nos
			c. Locker set			1 nos
	2.	CPU Remote I/O Room(Regeneration)	a. Chair			2 nos
			b. Key pad			1 nos
c. Locker set			1 nos			
3.	CPU Remote I/O Room(service vessel)	a. Chair		1 nos		
		b. Key pad		1 nos		
		c. Locker set		1 nos		

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 
<p>16.00.00</p> <p>17.00.00</p>	<p>For the items like Measuring Instruments, Process Connection and piping, Control Valves and Actuators, Other TG C&I systems, and Instrumentation and Power supply cables, contract quantities shall be governed by corresponding Sub-sections in Part-B.</p>



**TECHNICAL SPECIFICATION FOR
HYDROGEN GENERATION PLANT
2 X 800 MW NTPC GADERWARA STPP STAGE-I**

SPEC NO. PE-TS-394-168-A001

VOLUME-IIB

SECTION

REV.NO.0

DATE

SHEET

MEASURING INSTRUMENTS

MEASURING INSTRUMENTS	
1.00.00	MEASURING INSTRUMENTS
1.01.00	Measuring instruments/equipment and subsystems offered by the Bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Refer Sub-section Basic Design Criteria. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance. They shall comply with the acceptable international standards and shall be subject to Employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specifications, ranges, makes/numbers as approved by the Employer during detailed engineering.
1.02.00	Every panel-mounted instrument requiring power supply shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.
1.03.00	All local gauges as well as transmitters, sensors, and switches for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance as well as for operator and management information (including all computation) of equipment under the scope of specification shall be provided on as required basis within the quoted lump sum price. For bidding purpose, tentative minimum instruments have been indicated on the P&IDs. However, contractor shall supply any additional local gauges/switches/transmitters/sensors for reasons mentioned above without any additional cost to the Employer.
1.04.00	The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments, sensors; switches etc. for external connection including spare contacts shall be wired out in flexible/rigid conduits, independently to suitably located common junction boxes. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm.
1.05.00	For all instruments envisaged for sea water applications they shall be provided with wetted parts made of Monel / Hastelloy C or any other material (if proven ness experience of the proposed material for such applications is established by contractor:
1.06.00	All instruments shall be provided with durable epoxy coating for housings and all exposed surfaces of the instruments.

2.00.00	SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, D.P., FLOW AND LEVEL																																																			
2.01.00	<table><tr><th colspan="3">ELECTRONIC TRANSMITTERS</th></tr><tr><th>Sl.No.</th><th>Features</th><th>Essential/Minimum Requirements</th></tr><tr><td>1.</td><td>Type of Transmitter</td><td>Microprocessor based 2 wire type, Hart protocol compatible.</td></tr><tr><td>2.</td><td>Accuracy</td><td>± 0.1% of calibrated span (minimum)</td></tr><tr><td>3.</td><td>Output signal range</td><td>4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol)</td></tr><tr><td rowspan="2">4.</td><td rowspan="2">Turn down ratio</td><td>10:1 for vacuum/very low pressure applications.</td></tr><tr><td>30:1 for other applications.</td></tr><tr><td>5.</td><td rowspan="2">Stability</td><td>± 0.1% of calibrated span for six months for Ranges up to and including 70 Kg/cm².</td></tr><tr><td></td><td>± 0.25% of calibrated span for six months for Ranges more than 70 Kg/cm² (g).</td></tr><tr><td rowspan="2">6.</td><td rowspan="2">Zero and span drift</td><td>+/- 0.015% per deg.C at max span.</td></tr><tr><td>+/-0.11% per deg.C at min. Span.</td></tr><tr><td>7.</td><td>Load impedance</td><td>500 ohm (min.)</td></tr><tr><td>8.</td><td>Housing</td><td>Weather proof as per IP-55 with durable corrosion resistant epoxy coating.</td></tr><tr><td>9.</td><td>Over Pressure</td><td>150% of max. Operating pressure</td></tr><tr><td>10.</td><td>Connection (Electrical)</td><td>Plug and socket type</td></tr><tr><td>11.</td><td>Process connection</td><td>1/2 inch NPT (F)</td></tr><tr><td>12.</td><td>Span and Zero</td><td>Continuous, tamper proof, Remote as well as adjustability manual from instrument with zero suppression and elevation facility.</td></tr><tr><td>13.</td><td>Accessories</td><td>-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition.</td></tr></table>			ELECTRONIC TRANSMITTERS			Sl.No.	Features	Essential/Minimum Requirements	1.	Type of Transmitter	Microprocessor based 2 wire type, Hart protocol compatible.	2.	Accuracy	± 0.1% of calibrated span (minimum)	3.	Output signal range	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol)	4.	Turn down ratio	10:1 for vacuum/very low pressure applications.	30:1 for other applications.	5.	Stability	± 0.1% of calibrated span for six months for Ranges up to and including 70 Kg/cm².		± 0.25% of calibrated span for six months for Ranges more than 70 Kg/cm² (g).	6.	Zero and span drift	+/- 0.015% per deg.C at max span.	+/-0.11% per deg.C at min. Span.	7.	Load impedance	500 ohm (min.)	8.	Housing	Weather proof as per IP-55 with durable corrosion resistant epoxy coating.	9.	Over Pressure	150% of max. Operating pressure	10.	Connection (Electrical)	Plug and socket type	11.	Process connection	1/2 inch NPT (F)	12.	Span and Zero	Continuous, tamper proof, Remote as well as adjustability manual from instrument with zero suppression and elevation facility.	13.	Accessories	-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition.
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2.02.00			-2 valve manifold for absolute pressure transmitters (3-valve manifold for gauge/ vacuum pressure transmitters) and 5 valve manifold for DP/level/flow transmitters.
			-For hazardous area, explosions proof enclosure as described in NEC article 500.
	14.	Diagnostics	Self Indicating feature
	15.	Power supply	24V DC ± 10%.
	16.	Adjustment/calibration/maintenance	Centralised PC based system (In Station C&I Scope). In addition total two (2) no. of hand- held type universal calibrators per unit, compatible with HART protocol, shall be provided.
	Notes		
	In case it becomes necessary to use a DP transmitter for pressure measurement then a 3-valve manifold should be used in place of 2-valve manifold.		
	LVDT type is not acceptable.		
	Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.		
	GUIDED WAVE RADAR TYPE LEVEL TRANSMITTER		
Guided wave radar type level transmitters shall be provided for level measurements of the vessel under vacuum or low pressure applications.			
Type		Guided wave Radar	
Principle		TDR (Time domain reflectometry)	
Probe Type& Material		Coaxial, SS316/316L. If required, probe shall be suitable for overfill prevention.	
Signal o/p		4-20mA with HART signal suitable for overfill prevention.	
Display		Integral	
Power supply		24 VDC	

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	5	Calibration and accuracy	:	As per DIN-43760 Class-A for RTD
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	7	Accessories	:	Thermo well (as specified below) and shall be spring loaded for positive contacts with the well.
	8	Standard	:	DIN-43760 for RTD and ASME PTC-19.3 for Thermo-well.
	Metal Temperature Thermocouples			
	Measuring Medium		Metal Temperature	
	Material of Thermocouple.		Chromel Alumel Type K	
	Type of Thermocouple		Duplex with separate hot junctions, ungrounded	
	Insulation		Mineral Insulation Magnesium Oxide.	
	Thermocouple wire gauge		16 AWG	
	Protective sheath		SS 321	
	Protective sheath dia		8 mm O.D	
	Characteristics of Thermocouple		Special limits of error as in ANSI thermocouple MC 96.01.1975	
	Mounting accessories		1/2" BSP SS sliding end connector, weld pad, clamps of heat resistant steel SS310.	
Cold end sealing		SS pot weal with colour coded PTFE headed sleeve Insulated flexible tails. Sealing compound- Epoxy resin.		
Minimum bending radius		30 mm		
Length of T/C		30 Mtr. (minimum)		

3.04.00	<p>Thermo well (for all process temp. elements)</p> <ul style="list-style-type: none"> (a) Shall be one piece solid bored type of 315 SS of step-less tapered design. (As per ASME PTC 19.3 1974) (b) For Mill classifier outlet long life solid sintered tungsten carbide material of high abrasion resistance shall be provided. (c) For Air & Flue gas 316 SS protecting tube with welded cap. (However contractor shall provide better material for Flue gas service if require based on the specify boiler design parameters). (d) For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges.
4.00.00	<p>TEMPERATURE TRANSMITTER</p> <p>Following types of 2-wire temperature transmitter (directly powered from 4-20mA input cards of DDCMIS) shall be provided. The temperature transmitter shall be fully compatible with thermocouples and RTDs being provided by the contractor. Temperature compensation of the thermocouples shall be performed in the temperature transmitter itself.</p> <p>a. Single Input Head mounted Temperature Transmitter</p> <p>These shall be suitable for mounting in the head of temperature element itself. The protection class of head of thermo well along with its plug-in connector shall be min. IP65.</p> <p>b. Single Input DIN-rail mounted Temperature Transmitter</p> <p>These shall be suitable for mounting on DIN-rails in JB's. The specifications of the JB's shall be same as indicated in Subsection INST CABLE with additional DIN-rails and IP 65 Protection class. This temperature transmitter shall be the ones which are especially designed for DIN-rail mounting with IP 20 protection class. These shall have terminals for input/output provided on front side when mounted on DIN-rail. Head mounted temperature transmitter with clamps to make it suitable for DIN-rail mounting shall not be acceptable under this category.</p> <p>c. Dual-input Temperature Transmitter With Indicator:</p> <p>These shall be suitable for mounting on pipes/ support. Both elements of the duplex thermocouple/RTD shall be wired to a single transmitter. Indicator shall be provided with these transmitters. These transmitters shall have bump less change over facility to second sensor in case first sensor fails. This change-over is to be alarmed. Protection class shall be IP65 minimum.</p>

	d. Common requirements for each of the above type of temperature transmitters			
	Output	:	2-wire (power supply from input card of Control System) with 4-20mA output with superimposed HART protocol signal.	
	Input	:	Same transmitter shall be capable to handle Pt-100 RTD , Thermocouples –K&R types (input type to be selectable at site through HART terminal)	
	Isolation	:	min. 500 V AC	
	EMC compatibility	:	as per EN 61326	
	Operating ambient temperature	:	0 to 85 deg C (without indicator)	
			0 to 70 deg C (with indicator)	
	Power supply		compatible with input module of Control System	
	Accessories		Mounting arrangements including clamps etc.	
	Composite Accuracy	(a)	For head mounted and DIN-rail mounted types:	
	(Refer note 2)		RTD	=<0.4% of 0-250 deg C span
			T/C-K type	=<0.4% of 0-600 deg C span
			T/C-R type	=<0.4% of 0-1000 deg C span
			CJC accuracy (for thermocouples) shall be =< 1 deg C	
		(b)	For dual-input type:	
			RTD	=<0.25% of 0-250 deg C span
			T/C-K type	=<0.2% of 0-600 deg C span
			CJC accuracy (for thermocouples) shall be =< 1 deg C	
	Notes:-			
	1. In case of failure (open or burn-out) of RTD/thermocouple, temp. transmitter shall provide low temperature output.			

5.00.00	<p>2. Composite Accuracy is to be calculated as summation of all applicable accuracies of temp transmitter, for converting sensor input to output in 4-20 mA (e.g., basic accuracy, digital accuracy, D/A accuracy, etc.) and temperature effect on these accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of Temperature Elements specified. All such accuracy/ temp effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures.</p>	
	e. Field bus compatible temperature Transmitters	
	<p>Temperature transmitters of this category shall be field mounting type & shall be capable of withstanding operating ambient temperature upto 85 deg C. These modules shall be connected to DDCMIS through field bus such as Profibus, Foundation Field bus etc directly from the transmitter. Maximum Number of inputs per such temperature transmitter shall be eight. These shall be mounted in cabinets in non-AC areas.</p> <p>As an alternate, these signals from temperature transmitters can be connected to DDCMIS through standard remote I/O modules of the DCS, in which case, the temperature transmitter signals will be acquired through 4-20mA input modules in the remote I/O cabinet for connecting to DDCMIS through remote I/O bus.</p> <p>Air conditioned panel shall be provided for remote I/O.</p>	
	ANALYSER INSTRUMENTS:	
	Common Requirements	
	1	Output signals Analog 4-20 mA DC
		Binary 2 NO + 2 NC for high alarm
	2.	Zero & span Adjustment Available
	3.	Ambient temp. 50°C
	4.	Indication Digital
	5.	Enclosure Type/Material Weather & Dust proof (IP 55) Die cast Aluminium/SS
	6.	Type of Electronics Microprocessor based
	7.	Digital Signal transmission RS 232 Link & to suit connections protocol to DDCMIS

5.01.00	8.	Calibration	Auto & Manual (from Remote)
	9.	Error Diagnostic	To be provided
	10.	Others	If analyser provides superimposed HART signal on 4-20 mA DC output, It shall also be connected to PC based station (In Employer's Scope).
	Hydrogen Analyser		
	1.	Output signals:	Analog 4-20 mA DC
	2.	Zero & span Adjustment	Available
	3.	Ambient temp.	50°C
	4.	Indication	Digital
	5.	Enclosure Type/Material	Weather & Dust proof (IP 55) Die cast Aluminum/SS
	6.	Type of Electronics	Microprocessor based with self diagnostic facility
	7.	Digital Signal transmission protocol	RS 232 Link & to suit connections to Control System
	8.	Calibration	Auto & Manual (from Remote)
	9.	Error Diagnostic	To be provided
	10	Repeatability	± 1% of calibrated span
11	Linearity	± 2% of calibrated span	
5.02.00	PH Analyser		
	1.	TYPE	CELL - FLOW THROUGH
	2.	ACCURACY	< ± 1% OF SPAN
	3.	RANGE	0 - 14 PH, PROGRAMMABLE
	4.	NO. OF STEAMS	SINGLE
	5.	STABILITY	< 0.001 PH / WEEK
	6.	TEMP. COEFFICIENT / TEMP. ERROR	0.001 PH / DEG. C

6.00.00 6.01.00	7.	TYPE OF ELECTRONICS	MICROPROCESSOR BASED WITH SELF-DIAGNOSTIC FACILITY.
	8.	INDICATION	DIGITAL
	9.	ENCLOSURE	WEATHER DUST PROOF (IP55) DIE CAST ALUMINUM.
	SPECIFICATION FOR FLOW ELEMENTS		
	Orifice Plate		
	Features		Essential/Minimum Requirements
	Type		Concentric as per ASME PTC-19.5 (Part-II), ISA RP-3.2, 1960 or BS-1042
	Material		316 SS
	Thickness		3 mm for main pipe diameter up to 300 mm and 6 mm for main pipe dia above 300 mm.
	Material of branch pipe		Same as main pipe
	Root valve type		Globe
	Root valve material		316 SS
	Root valve size		1 inch
	Impulse pipe of same material up to root valve		Required
	Tappings		Flanged weld neck. 3 pairs. of tapping.
Beta Ratio		0.34 to 0.7	
Beta Ratio calculation to be submitted		Yes	
Assembly drg. and flow Vs DP Curves		Yes	
Accessories		Root valves, flanges, Vent/drain hole(As required)	

6.02.00	<p>Contractor shall submit certified flow calculation and differential pressure vs. flow curves for each element for Employer's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Employer's approval. One Flow element of each type shall be calibrated in the test laboratory for validation of commutated flow calculations.</p>																												
	Flow Nozzle																												
	<table><tr><td>Features</td><td>Essential/Minimum Requirements</td></tr><tr><td>Type</td><td>Long radius, welded type as per ASME PTC-19.5 (Part-III) or BS-1042</td></tr><tr><td>Material</td><td>316 SS</td></tr><tr><td>Thickness</td><td>Suitable for intended application.</td></tr><tr><td>Material of branch pipe</td><td>Same as main pipe</td></tr><tr><td>Root valve type</td><td>Globe</td></tr><tr><td>Root valve material</td><td>316 SS</td></tr><tr><td>Root valve size</td><td>1 inch</td></tr><tr><td>Impulse pipe of same material up to root valve</td><td>Required</td></tr><tr><td>Tapping</td><td>D and D/2 (3 sets of tapings points)</td></tr><tr><td>Beta Ratio</td><td>Around 0.7</td></tr><tr><td>Beta Ratio calculation to be submitted</td><td>Yes</td></tr><tr><td>Assembly drg. and flow Vs DP Curves</td><td>Yes</td></tr><tr><td>Accessories</td><td>Root valves, vent and drain hole.</td></tr></table>	Features	Essential/Minimum Requirements	Type	Long radius, welded type as per ASME PTC-19.5 (Part-III) or BS-1042	Material	316 SS	Thickness	Suitable for intended application.	Material of branch pipe	Same as main pipe	Root valve type	Globe	Root valve material	316 SS	Root valve size	1 inch	Impulse pipe of same material up to root valve	Required	Tapping	D and D/2 (3 sets of tapings points)	Beta Ratio	Around 0.7	Beta Ratio calculation to be submitted	Yes	Assembly drg. and flow Vs DP Curves	Yes	Accessories	Root valves, vent and drain hole.
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7.00.00	SPECIFICATIONS FOR PR. GAUGE, D.P. GAUGE, TEMP. GAUGE AND LEVEL GAUGE.				
	Sl. No	FEATURES	ESSENTIAL/MINIMUM REQUIREMENTS		
			Pr. Gauge/ DP Gauge/ Draught gauges	Temperature Gauge	Level Gauge
	1	Sensing Element and material	Bourdon for high pressure, Diaphragm/ Bellow for low pr. Of 316 SS	Mercury in steel for below 450°C and inert gas actuated for above 450°C of SS bulb and capillary.	Tempered * toughened Borosilicate gauge glass steel armoured reflex or transparent type.
	2	Body material	Die-cast aluminium	Die-cast aluminium	Forged carbon steel/304 SS
	3	Dial size	150mm	150 mm	Tubular covering entire range
	4	End connection	1/2 inch NPT (M)	3/4" NPT (M)	Process connection as per ASME PTC and drain/vent 15 NB
	5	Accuracy	±1% of span	± 1% of span	± 2%
	6	Scale	Linear, 270° arc graduated in metric units	Linear, 270° arc graduated in °C	Linear vertical
	7	Range selection	Cover 125% of max. of scale	Cover 125% of max. of scale	Cover 125% of max. of scale
	8	Over range test	Test pr. for the assembly shall be 1.5 to the max. Design pr. at 38°C.		
	9	Housing	Weather and dust proof as per IP-55	Weather and dust proof as per IP-55	CS/304 SS leak proof
	10	Zero/span adjustment	Provided	Provided	--
	11	Identification	Engraved with service legend or laminated phenolic name plate		


8.00.00	12	Accessories	Blow out disc, siphon, snubber, pulsation dampener, chemical seal (if required by process) gauge isolation valve	SS Thermowell	Gasket for all KEL-F shield for transparent type vent and drain valves of Steel/SS as per CS/Alloy process Requirement.
	13	Material of Bourdon/movement	316 SS / 304 SS	316 SS / 304 SS	
	Notes:-				
	*Bicolour type level gauges will be provided for applications involving steam and water except for condensate and feed water services.				
	Length of gauge glass shall not be more than 1400 mm. If the vessel is higher, multiple gauge glasses with 50 mm overlapping shall be provided.				
	Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.				
	ROTAMETERS				
	SR. NO.	FEATURES	ESSENTIAL / MINIMUM REQUIREMENTS		
	1.	TYPE	VARIABLE AREA METAL TUBE		
	2.	FLUID MEDIA	WATER/OIL		

3.	TUBE BODY	SS316		
4.	MATERIAL OF FLOAT	316 SS		
5.	INDICATOR	LINEAR SCALE		
6.	ACCESSORIES	FLANGE, ORIFICE IN CASE OF BYPASS ROTA METER (FOR LINE SIZE ABOVE 100 MM)		
7.	HOUSING PROTECTION CLASS	IP-55		


9.00.00	8.	ACCURACY	± 2% OF MEASURED VALUE.		
	PROCESS ACTUATED SWITCHES				
	FEATURES		ESSENTIAL / MINIMUM REQUIREMENTS		
		Pressure/ Draft Switches/ DP Switches	Temperature switches	Level switches	
	Sensing Element	Piston actuated for high pressure and diaphragm or bellows for low pr./ vacuum	Vapor pressure sensing, liquid filled bellow type with SS bulb and capillary (10 m minimum)	Capacitance types for oil and dirty medium, water, condensate application.	
				Float type switches for applications as decided by Employer during detailed engineering.	
				Capacitance/ Conductivity/ Ultrasonic type for acid and alkali application.	
				Radio-frequency/ Ultrasonic type for ash hopper, ash slurry application.	
	Material	316 SS	Bulb 316 SS/ capillary 304 SS	316 SS	
	End connection	½ inch NPT (F)	½ inch NPT (F)	Manufacturer standard	
	Over range proof pressure	150% of max. design pr.	-	150% of max. design pressure	
	Repeatability	± 0.5% of full range			
	No. of contacts	2 No.+2NC. SPDT snap action dry contact			
	Rating of contacts	60 V DC, 6 VA (or more if required by DDCMIS)			
	Elect. Connection	Plug in socket.			

10.00.00				
	Set point/ dead band adjustment	Provided over full range.		
	Enclosure	Weather and dust proof as per IP-55		
	Accessories	Siphon, snubber, chemical seal, pulsation dampeners as required by process	Thermo well of 316 SS and packing glands	All mounting accessories
	Mounting	Suitable for enclosure/ rack mounting or direct mounting	Suitable for rack mounting or direct mounting	-
	Power Supply (wherever required)	24 V DC, to be arranged by Contractor except for Ash Level Switches, where the same shall be as per Contractor's Standard practice.		
	Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.			
	DEW POINT METER			
	Sensor			
	Type	:	Capacitance type with change in output proportional to moisture present.	
Service	:	Dry Air		
Range	:	-50 to 0 Degree Centigrade Dew-Point		
Sensor Accuracy	:	Better than +/-0.5^		
Operating Temperature	:	0 to 50 degree C.		
Operating Pressure	:	0-10 Kg./Cm2, suitable for process application.		


	Analyser	
	Input	: Change in capacitance from dew point sensor.
	Display	: Combined enclosure with two three-digit seven segments LED display with decimal point after two digits. LED height shall be 4 inches, clearly legible from a distance of atleast 10 meters.
	Range	: -50 to 0 Degree Centigrade Dew-Point
	Display Accuracy	: Better than ± 2 Degree C.
	Mounting	: Table top/Flush mounting, to be finalised during detailed engineering.
	Power supply	: 240V AC, 50 Hz to be arranged by the contractor.
	Output	: 5-20 mA DC capable of driving a load impedance of 500 ohms minimum.
<p>4-20 mA DC Output signal is to be connected to control system in Contractor's Scope (Interconnection cables are to be provided by the Contractor).</p> <p>In case the system is not suitable for Direct online mounting, then all the required sampling system is to be provided by the contractor.</p> <p>All required accessories including cables, sensor holder, desiccant chambers, mounting fixtures etc. are to be supplied by the Contractor within his quoted lumpsum price.</p>		


CLAUSE NO.	TECHNICAL REQUIREMENTS		
	CONTROL VALVES, ACTUATORS & ACCESSORIES		
1.00.00	CONTROL VALVES, ACTUATORS & ACCESSORIES		
1.01.00	General Requirements		
1.01.01	The control valves and accessories equipment furnished by the Bidder shall be designed constructed and tested in accordance with the latest applicable requirements of code for pressure piping ANSI B 31.1, the ASME Boiler & pressure vessel code, Indian Boiler Regulation (IBR), ISA, and other standards specified elsewhere as well as in accordance with all applicable requirements of the "Federal Occupational Safety and Health Standards, USA" or acceptable equal standards. All the Control Valves, their actuators and accessories to be furnished under this Sub-section will be fully suitable and compatible with the modulating loops covered under the Specification.		
1.01.02	All the control valves and accessories offered by the Bidder shall be from reputed, experienced manufacturers of specified type and range of valves.		
1.01.03	For special type of control valves such as combined pressure and temperature control valves for Aux PRDS application, separator drain control valves, refer to the corresponding mechanical sections.		
1.02.00	CONTROL VALVE SIZING & CONSTRUCTION		
1.02.01	The design of all valve bodies shall meet the specification requirements and shall conform to the requirements of ANSI (USA) for dimensions, material thickness and material specification for their respective pressure classes.		
1.02.02	The valve sizing shall be suitable for obtaining maximum flow conditions with valve opening at approximately 80% of total valve stem travel and minimum flow conditions with valve stem travel not less than 10% of total valve stem travel. All the valves shall be capable of handling at least 120% of the required maximum flow. Further, the valve stem travel range from minimum flow condition to maximum flow condition shall not be less than 50% of the total valve stem travel. The sizing shall be in accordance with the latest edition of ISA handbook on control valves. While deciding the size of valves, Bidder shall ensure that valves trim exit outlet velocity as defined in ISA handbook does not exceed 8 m/sec for liquid services, 150 m/sec. for steam services and 50% of sonic velocity for flashing services. Bidder shall furnish the sizing calculations clearly indicating the outlet velocity achieved with the valve size selected by him as well as noise calculations, which will be subject to Employer's approval during detailed engineering.		
1.02.03	Control valves for steam and water applications shall be designed to prevent cavitation, wire drawing, flashing on the downstream side of valve and down stream piping. Thus for cavitation/flashing service, only valve with anti cavitation trim shall be provided. Detailed calculations to establish whether cavitation will occur or not for any given application shall be furnished.		
1.02.04	Control valves for application such as SH Spray Control, RH spray Control, Heavy Oil Heating, pressurizing and Control system shall have permissible leakage rate as per leakage Class V. All other control valves shall have leakage rate as per leakage Class-IV.		
1.02.05	The control valve induced noise shall be limited to 85 dBA at 1 meter from the valve surface under actual operating conditions. The noise abatement shall be achieved by valve body and trim design and not by use of silencers.		

CLAUSE NO.	TECHNICAL REQUIREMENTS	<div>एनटीपीसी NTPC</div>			
2.00.00	VALVE CONSTRUCTION				
2.01.00	All valves shall be of globe body design & straightaway pattern with single or double port, unless other wise specified or recommended by the manufacturer to be of angle body type. Rotary valve may alternatively be offered when pressure and pressure drops permit.				
2.02.00	Valves with high lift cage guided plugs & quick-change trims shall be supplied.				
2.03.00	Cast Iron valves are not acceptable.				
2.04.00	Bonnet joints for all control valves shall be of the flanged and bolted type or other construction acceptable to the Employer. Bonnet joints of the internal threaded or union type will not be acceptable.				
2.05.00	Plug shall be of one-piece construction cast, forged or machined from solid bar stock. Plug shall be screwed and pinned to valve stems or shall be integral with the valve stems.				
2.06.00	All valves connected to vacuum on down stream side shall be provided with packing suitable for vacuum applications (e.g. double vee type chevron packing)				
2.07.00	Valve characteristic shall match with the process characteristics.				
2.08.00	Extension bonnets shall be provided when the maximum temperature of flowing fluid is greater than 280 deg. C.				
2.09.00	Flanged valves shall be rated at no less then ANSI press class of 300 lbs.				
3.00.00	VALVE MATERIALS				
	Sr. No.	Service	Body material	Trim Material	
	1	Non-corrosive, non-flashing and non-cavitation service except DM water	Carbon steel ASTM-A216 Gr. WCB for fluid temperature below 275 Deg. C Alloy steel ASTM-A217Gr. WC9 for fluid temperature above 275 Deg. C	316SS stellited with stellited faced guide posts and bushings.	
	2.	Severe flashing/cavitati on services	Alloy steel ASTM-A217 Gr. WC9	440 C	
	3.	Low flashing/cavitati on service	Alloy steel ASTM-A217 Gr. WC6	17-4 PH SS	
	4.	DM water service	316 SS	316 SS	
	NOTE Valve body rating shall meet the process pressure and temperature requirement as per ANSI B16.34.				
	However, Bidder may offer valves with body and trim materials better than specified materials and in such cases Bidder shall furnish the comparison of properties including cavitation resistance, hardness, tensile strength, strain energy, corrosion resistance and erosion resistance etc. of the offered material vis-a-vis the specified material for Employer's consideration and approval.				

CLAUSE NO.	TECHNICAL REQUIREMENTS																					
4.00.00	END PREPARATION Valve body ends shall be either butt welded/socket welded, flanged (Rubber lined for condensate service) or screwed as finalized during detailed engineering and as per Employer's approval. The welded ends wherever required shall be butt welded type as per ANSI B 16.25 for control valves of sizes 65 mm and above. For valves size 50 mm and below welded ends shall be socket welded as per ANSI B 16.11. Flanged ends wherever required shall be of ANSI pressure-temperature class equal to or greater than that of the control valve body.																					
5.00.00	VALVE ACTUATORS All control valves shall be furnished with pneumatic actuators except for pressure and temperature control valve for auxiliary PRDS application (electro-hydraulic / pneumatically operated) and separator drain control valve (electro-hydraulic type).The Bidder shall be responsible for proper selection and sizing of valve actuators in accordance with the pressure drop and maximum shut off pressure and leakage class requirements. The valve actuators shall be capable of operating at 60 deg.C continuously. Valve actuators and stems shall be adequate to handle the unbalanced forces occurring under the specified flow conditions or the maximum differential pressure specified. An adequate allowance for stem force, at least 0.15 Kg/sq.cm. per linear millimeter of seating surface, shall be provided in the selection of the actuator to ensure tight seating unless otherwise specified. The travel time of the pneumatic actuators shall not exceed 10 seconds.																					
6.00.00	CONTROL VALVE ACCESSORY DEVICES																					
6.01.00	All pneumatic actuated control valve accessories such as air locks, hand wheels/hand-jacks, limit switches, microprocessor based electronic Positioner, diffusers, external volume chambers, position transmitters (capacitance or resistance type only), reversible pilot for Positioner, tubing and air sets, solenoid valves and junction boxes etc. shall be provided as per the requirements.																					
7.00.00	SPECIFICATIONS FOR MICROPROCESSOR BASED ELECTRONIC POSITIONER <table><tr><td rowspan="4">1</td><td rowspan="4">Electrical</td><td>a) Input Demand Signal</td><td>4-20 mA</td></tr><tr><td>b) Power Supply</td><td>Loop Powered from the output card of Control System.</td></tr><tr><td>c) HART Protocol</td><td>Compatibility for Remote Calibration & Diagnostics (Super-imposed HART signal on input Signal (4-20 mA)</td></tr><tr><td>d. Valve position sensing</td><td>Position sensing, 4-20 mA output signal to be provided for control system.</td></tr><tr><td rowspan="3">2</td><td rowspan="3">Environment</td><td>a) Operating temp.</td><td>(-)30 To 80 Deg. C</td></tr><tr><td>b) Humidity</td><td>0-95 %</td></tr><tr><td>c) Protection class</td><td>IP-65 Minimum</td></tr></table>				1	Electrical	a) Input Demand Signal	4-20 mA	b) Power Supply	Loop Powered from the output card of Control System.	c) HART Protocol	Compatibility for Remote Calibration & Diagnostics (Super-imposed HART signal on input Signal (4-20 mA)	d. Valve position sensing	Position sensing, 4-20 mA output signal to be provided for control system.	2	Environment	a) Operating temp.	(-)30 To 80 Deg. C	b) Humidity	0-95 %	c) Protection class	IP-65 Minimum
1	Electrical	a) Input Demand Signal	4-20 mA																			
		b) Power Supply	Loop Powered from the output card of Control System.																			
		c) HART Protocol	Compatibility for Remote Calibration & Diagnostics (Super-imposed HART signal on input Signal (4-20 mA)																			
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2	Environment	a) Operating temp.	(-)30 To 80 Deg. C																			
		b) Humidity	0-95 %																			
		c) Protection class	IP-65 Minimum																			
				i																		

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी</div> <div>NTPC</div>
	3	Software for Configuration and Diagnostics	Software	Windows based software. Software shall meet the requirements for Configuration, Diagnostics, Calibration and Testing of the actuator.
			Diagnostic/Test features	Advanced diagnostic features like Stroke counter or Travel counter, Leakage in actuators, Valve Signature analysis, Step Response test, Valve friction /Jamming detection etc to be provided.
	4	Test reports/ Certificates	Factory Valve Signature Tests Reports (Pr Vs Valve travel and Travel Vs I/P signal) are to be provided.	
			Test certificates as per Manufacture Standard/Relevant Standard are to be submitted.	
	5	Configuration/ Calibration.	Remote & Local Calibration, Auto & Manual Calibration shall be possible.	
	6	Operating Range	Full range/ Split range.	
	7	Modes	Valve Action	Direct / Reverse Valve Action
			Flow Characterization	Possible to fit Valve Characteristic Curves- Linear , Equal percentage etc.
	8	Fail Safe/Fail Freeze	Fail Safe/Fail Freeze feature is to be provided. (In case the fail freeze feature is not intrinsic to the positioner, Bidder shall achieve the same externally through solenoid valve connected in the pneumatic circuit).	
	9	Pneumatic	Air capacity	Sufficient to handle the valves & actuators selected/ Boosters to be supplied, if required.
			Air pressure	To suit the air supply pressure/quality available.
			Process connection	¼" NPT
	10	Performance	Characteristic deviation	<=0.5 % of span.
			Ambient temp effect	<=0.01 %/ deg C or better.

CLAUSE NO.	<div style="text-align: right;">  </div> TECHNICAL REQUIREMENTS			
	10	EMC & CE Compliance	Required to International Standard like EN/IEC.	EN50081-2 & EN50082 or equivalent.
	11	Accessories	In-built Operator Panel	Display with push buttons for configuration and display on the positioner itself (Password protected/Hardware lock).
			Hand Held Hart Calibrator	Universal Hart Calibrator to be provided (for quantity, refer <i>Part-A: Contract quantities</i> of the specification).
			Press Gauge Block	For supply & output pressures, Air Filter Regulator and other accessories shall be provided on as required basis for making system complete.
			Electrical Cable Entry	1/2"NPT, side or bottom entry to avoid water ingress.
			Valves Mounting Assembly	For Sliding Stem/Rotary/Single acting/Double acting actuators on as required basis
	<p>* Note:</p> <p>Employer is providing a centralized HART management system including the HART multiplexing/ interfacing system. The HART signals shall be picked up from marshalling terminals of DDCMIS (SG/TG DDCMIS as well as BOP DDCMIS), as applicable. The details of the above mentioned employer's HART management system are as below:</p> <p>The following functionalities are achieved through industry standard softwares of the HART management system for electronic transmitters, temperature transmitters and analysers:</p> <ol style="list-style-type: none"> Constant scanning to monitor faults or changes to instrument configuration. Employer-defined and standard calibration and configuration procedures for all transmitters. Constant signal data collection facilities to maintain continuously updated records. Automatic tracking of configuration changes made in the field, such as may be introduced by hand-held communicator. All configuration function associated with hand-held communicators shall be available in the system. Event and log reports on screen as well as on printer. 			

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<p>f) Any addition/deletion of transmitter will be reported on printer and logged in hard disk.</p> <p>Further, the positioners shall be monitored from the above described HART management system .To achieve this, Bidder shall provide the necessary software to achieve the functionalities described above under "Remote Configuration and Diagnostics", and this software shall be loaded in the Employer's HART management system.</p>			
8.00.00	<p>TEST AND EXAMINATION</p> <p>All valves shall be tested in accordance with the quality assurance programme agreed between the Employer and Contractor, which shall meet the requirements of IBR and other applicable codes mentioned elsewhere in the specifications. The tests shall include but not be limited to the following:</p>			
8.01.00	Non Destructive Test as per ANSI B-16.34.			
8.02.00	Hydrostatic shell test in accordance with ANSI B 16.34 prior to seat leakage test.			
8.03.00	Valve closure test and seat leakage test in accordance with ANSI-B 16.34 and as per the leakage class indicated above.			
8.04.00	Functional Test: The fully assembled valves including actuators control devices and accessories shall be functionally tested to demonstrate times from open to close position.			
8.05.00	<p>CV Test: Please refer CI No. 1.00.00, Sub-section-IV:19 (Type test requirements), Control Valves.</p> <p>Bidder shall furnish all the control valves under this main plant package as finalized during detailed engineering stage without any price repercussions whatsoever depending on the process requirements. All the control valves provided by the Bidder for this project shall meet the specifications requirements specified herein. Specification for control valves in this Sub-section has to be read in conjunction with other relevant Sub-sections of this specification.</p>			

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
10.00.00	<p>FIELD MOUNTED LOCAL JUNCTION BOXES</p> <p>(i) No. of ways 12/24/36/48/64/72/96/128 with 20% spares terminals.</p> <p>(ii) Material and Thickness 4mm thick Fiberglass Reinforced Polyester (FRP).</p> <p>(iii) Type Door gasket shall be of synthetic rubber.</p>			

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	<p>(iv) Mounting clamps and accessories</p> <p>(v) Type of terminal blocks</p> <p>(vi) Protection Class</p> <p>(vii) Grounding</p> <p>(viii) Color</p>	<p>Suitable for mounting on walls, columns, structures etc. The brackets, bolts, nuts, screws, glands and lugs required for erection shall be of brass, included in Bidders scope of supply. Raceways shall be provided inside JBs for proper termination of cables.</p> <p>Rail mounted cage-clamp type suitable for conductor size upto 2.5 mm². A M6 earthing stud shall be provided.</p> <p>IP: 55 minimum for indoor & IP-65 minimum for outdoor applications.</p> <p>To be provided.</p> <p>To be decided during detailed engineering & subject to Employer's approval.</p>		

SPECIFICATION NO.:

VOLUME

SECTION

REV. NO.

SHEET

DATE:

OF 1

Data Sheet No.: **PE-DC-999-145-I026-0**

(TO BE FILLED-
UP/CONFIRMED BY
BIDDER)

GENERAL	MANUFACTURER				
	MODEL NUMBER				
TECHNICAL	SENSING ELEMENT		<input type="checkbox"/> BOURDON <input type="checkbox"/> DIAPHRAGM (BOURDON FOR HIGH PRESS AND DIAPHRAGM FOR LOW PRESS APPLICATION)		
	MATERIAL		SENSING ELEMENT – AISI 316 SS MOVEMENT – AISI 304 SS CASING – ■ DIE CAST AL <input type="checkbox"/> SS		
	ENCLOSURE		CLASS: ■ IP-55 <input type="checkbox"/> IP-65 <input type="checkbox"/> EXPL PROOF PAINT: ■ ENAMEL <input type="checkbox"/> EPOXY		
	DIAL		SIZE: 150 MM COLOR: WHITE NUMERALS: BLACK SCALE: LINEAR, 270° ARC GRADUATED IN METRIC UNITS		
	CASE		COLOUR : BLACK		
	SPAN/ ZERO ADJUSTMENT		INT. MICRO SCREW		
	RANGE SELECTION		SHOULD COVER 125% OF OPRATING PARAMETER		
	OVER RANGE PROTECTION		1.5 TIMES OF FSD		
	BLOW OUT DISC		REQUIRED		
	SWITCHING FACILITY (IF APPLICABLE)		NOT REQUIRED		
	TYPE		<input type="checkbox"/> MICRO SWITCH		



**CHECK LIST FOR
PRESSURE / DIFFERENTIAL PRESSURE GAUGE
(Mechanical Auxiliary Packages)**

SPECIFICATION NO.:

VOLUME

SECTION

REV. NO.

DATE:

SHEET 1 OF 1

Data Sheet No.: **PE-CL-999-145-1026-0**

SL NO	TESTS/CHECKS	QUANTM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS	AGENCY			REMARKS
				P	W	V	
1.0	CHECK FOR		APPROVED TECHINCAL REQUIREMENT/ DATA SHEET				MFR TO CARRY OUT ROUTINE TEST ON 100%. WHEN MATL CORELATION ARE NOT AVAILABLE MFR'S COMPLIANCE TO BE PROVIDED
1.1	DIAL SIZE	100%		M	C	C	
1.2	MODEL NO/TAG NO	100%		M	C	C	
1.3	RANGE/SCALE	100%		M	C	C	
1.4	END CONNECTION	100%		M	C	C	
1.5	SWITCH CONTACT RATING & NOS	100%		M	C	C	
2.0	CALIBRATION						
2.1	ACCURACY	100%		M	C	B	
2.2	REPEATABILITY (FOR SWITCH)	100%		M	C	B	
2.3	SET POINT ADJUSTMENT FOR SWITCH	100%		M	C	C	
3.0	OVER PRESSURE & LEAK TEST	100%		M	C	C	
4.0	OPERATION OF PR. RELIEF DEVICE	ONE PER TYPE		M	C	C	
5.0	REVIEW OF T.C. FOR MATERIAL OF--						
5.1	SENSOR	FOR LOT		-	-	B	
5.2	MOVEMENT			-	-	B	
5.3	PROCESS CONNECTION		-	-	B		
5.4	HOUSING		-	-	B		
6.0	REVIEW OF T.C. FOR DEGREE OF PROTECTION	TYPE TEST	-	-	B		
7.0	REVIEW OF T.C. FOR CONTACT RATING OF SWITCH	ONE PER TYPE	-	-	B		
8.0	ACCESSORIES AS APPLICABLE	100%	M	C	C		
LEGEND: M: MANUFACTURER/ SUB CONTRACTOR, C: CONTRACTOR/ NOMINATED INSP AGENCY, B: BHEL. P: PERFORM, W: WITNESS, V: VERIFICATION. NOTE: CONTRACTOR TO PROVIDE COMPLIANCE CERTIFICATE FOR TESTS/CHECKS VERIFIED BY CONTRACTOR AND SUBMIT THE SAME ALONGWITH TEST CERTIFICATES TO BE VERIFIED BY BHEL.							
	PREPARED BY	CHECKED BY	APPROVED BY				
NAME	S C NARANG/ MAYANK KESHARWANI	DIPESH PALIT	SHAIENDRA BHATNAGAR				
SIGNATURE							
DATE	21.08.08	21.08.08	21.08.08				

	SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE & D.P.		
	ELECTRONIC TRANSMITTERS		
	Sr. No.	Features	Essential/Minimum Requirements
	1.	Type of Transmitter	Microprocessor based 2 wire type, Hart protocol compatible.
	2.	Accuracy	± 0.1% of calibrated span (minimum)
	3.	Output signal range	4-20 mA DC (Analog) alongwith superimposed digital signal (based on HART protocol)
	4.	Turn down ratio	10:1 for vacuum/very low pressure applications. 30:1 for other applications.
	5.	Stability	± 0.1% of calibrated span for six months for Ranges up to and including 70 Kg/cm². ± 0.25% of calibrated span for six months for Ranges more than 70 Kg/cm²(g).
	6.	Zero and span drift	+/- 0.015% per deg.C at max span. +/-0.11% per deg.C at min. span.
	7.	Load impedance	500 ohm (min.)
	8.	Housing	Weather proof as per IP-55 with durable corrosion resistant coating.
	9.	Over Pressure	150% of max. Operating pressure
	10.	Connection (Electrical)	Plug and socket type
	11.	Process connection	1/2 inch NPT (F)

	<p>12. Span and Zero</p> <p>Continuous, tamper proof, Remote as well as adjustability manual from instrument with zero suppression and elevation facility.</p> <p>13. Accessories</p> <p>-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition.</p> <p>-2 valve manifold for absolute pressure transmitters (3-valve manifold for gauge/ vacuum pressure transmitters) and 5 valve manifold for DP/level/flow transmitters.</p> <p>-For hazardous area, explosions proof enclosure as described in NEC article 500.</p> <p>14. Diagnostics</p> <p>Self Indicating feature</p> <p>15. Power supply</p> <p>24V DC \pm 10%.</p> <p>Notes :</p> <p>In case it becomes necessary to use a DP transmitter for pressure measurement then a 3-valve manifold should be used in place of 2-valve manifold.</p> <p>LVDT type is not acceptable.</p> <p>Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.</p>		



SPECIFICATION FOR LEVEL GAUGES

SPECIFICATION NO. : PES - 145 - 28A

VOLUME II B

SECTION D

REV. NO. 01 DATE 27.03.95

SHEET 1 OF 2

1.0 TECHNICAL REQUIREMENTS

1.1 General

The Level Gauges shall be suitable for continuous operation under ambient temperature of 0-55°C and Relative Humidity of 0-95%.

1.2 Type of Level Gauge

The Level Gauge shall be Tubular or Transparent or Reflex or Magnetic type as specified in Data Sheet-A and shall be suitable for the specified service conditions.

1.2.1 Tubular Type

Borosilicate transparent glass tube shall be mounted between the top & bottom valve assemblies.

1.2.1.1 Gauge glass body: Body construction and assembly shall be suitable for on line replacement of the Glass tube without interrupting the equipment operation.

1.2.1.2 Protector: A tubular metallic protector with a slit in front for reading the level, shall be provided surrounding the gauge glass. The inside surface of the protector shall be painted yellow or white for clear visibility.

1.2.1.3 Ball Check: Ball check arrangement shall be provided inside the integral gauge glass valve body for automatic shut off and to prevent leakage of liquid during glass tube breakage under pressure or vacuum service.

1.2.1.4 Drain/Vent: The level gauge shall be provided with suitable venting arrangement on the upper arm and a drain valve/cock on the lower arm.

1.2.2 Transparent Type

Borosilicate toughened glass bars shall be mounted between the forged metal covers with top & bottom valve assemblies.

1.2.2.1 Ball Check: Ball check arrangement shall be provided inside the integral gauge glass valve body for automatic shut off and to prevent leakage of liquid during glass tube breakage under pressure or vacuum service.

1.2.2.2 Drain/Vent: The level gauge shall be provided with suitable venting arrangement on the upper arm and a drain valve on the lower arm.

1.2.2.3 Illuminator: Proper illuminating arrangement shall be provided for better visibility of the liquid level.

1.2.3 Reflex Type

Borosilicate toughened Reflex type glass bars shall be mounted between the forged metal covers with top & bottom valve assemblies.



SPECIFICATION FOR LEVEL GAUGES

SPECIFICATION NO. : PES - 145 - 28A

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SECTION D

REV. NO. 01 | DATE 27.03.95

SHEET 2 OF 2

1.2.3.1 Ball Check: Ball check arrangement shall be provided inside the integral gauge glass valve body for automatic shut off and to prevent leakage of liquid during glass tube breakage under pressure or vacuum service.

1.2.3.2 Drain/Vent: The level gauge shall be provided with suitable venting arrangement on the upper arm and a drain valve on the lower arm.

1.2.4 Magnetic Type

Magnetic type level gauge shall be suitable for either direct or indirect mounting as specified in Data Sheet-A. Direct type shall be suitable for mounting externally at the side of the vessel, while Indirect type shall be suitable for mounting at the top of the vessel. The level indication shall be by means of either rolling magnet or Iron ball follower, as specified in Data Sheet-A.

2.0 TESTING AND INSPECTION

2.1 The bidder shall adopt suitable quality assurance plan to ensure that the equipments offered will meet the specification requirements in full.

2.2 The bidder shall furnish the Quality Plan in the format enclosed in volume-III. In case the Quality Plan(s) is/are included in volume-IIB, the bidder shall furnish his Quality Plan strictly in line with the same. The Quality Plan shall be discussed and finalised with the technically accepted bidders before opening the price bid. The stages where the purchaser would like to be associated for witnessing or verification would be indicated by the purchaser in the Quality Plan before approval.

2.3 The following test shall be conducted as a minimum requirement.

- a) Hydraulic pressure test for the complete gauge glass assembly at 1.25 times the maximum operating pressure.
- b) Thermal shock test for glass.

2.4 Inspection will be conducted by BHEL and/or their authorised representatives as per the agreed inspection schedule. The inspection schedule will be submitted by the bidder for BHEL's approval at contract stage. The cost of all tests and inspections will be deemed to have been included in the bid. For all the type tests covered under 2.3, "Type Test Certificates" as per agreed Quality Plan shall be furnished. In the absence of the same, such Type Tests shall be arranged at the Vendor's works in the presence of BHEL and/or their authorised representatives or in independent Test House/Laboratory approved by BHEL.

3.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Level Gauges : Data sheet no. PES-145-28A-DS1-0
- Data sheet C for Level Gauges : Data sheet no. PES-145-28A-DS2-0



DATA SHEET FOR LEVEL GAUGES

SPECIFICATION NO.:

VOLUME

SECTION

REV. NO.

DATE

SHEET

1

OF

1

Data Sheet No.: PES-145-28A-DS1-0

DATA SHEET **A**

Sl. No.	Description	Data Sheet-A (To be filled in by Purchaser)	<i>Is applicable. To be confirmed by bidder.</i>
A.	GENERAL		
1.	Manufacturer		
2.	Model Number		
3.	Tag Number		
4.	Service		
	a) Max. Operating Pressure		
	b) Max. Operating Temp.		
5.	Range		
B.	TECHNICAL		
1.	Type	Tubular <input checked="" type="checkbox"/> Transparent <input type="checkbox"/> Reflex <input type="checkbox"/> Magnetic: Rolling Magnet <input type="checkbox"/> Iron bar <input type="checkbox"/> (with metallic tube protects with a slit)	
2.	Mounting	Direct <input checked="" type="checkbox"/> Indirect <input type="checkbox"/> Top <input type="checkbox"/> Side <input checked="" type="checkbox"/>	
3.	Material		
	Body	ASTM: A105 <input type="checkbox"/> SS304 <input checked="" type="checkbox"/> SS316 <input type="checkbox"/>	
	Ball	SS-304	
	Spindle/Gland	SS-304	
	Gasket	Neoprene <input checked="" type="checkbox"/> Teflon <input type="checkbox"/> Other <input type="checkbox"/>	
	Glass Tube/Glass plate	Borosilicate Toughened	
	Valves	SS-304 <input checked="" type="checkbox"/>	
	Hand wheel	Malleable iron	
	Bolt & Nuts	High Tensile steel	
	Chamber	SS-304 <input type="checkbox"/> SS-316 <input type="checkbox"/> Other <input type="checkbox"/>	
	Float	SS-304 <input type="checkbox"/> SS-316 <input type="checkbox"/> Other <input type="checkbox"/>	
4.	Illuminator	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
	a) Class of protection	IP 55 <input type="checkbox"/> IP 65 <input type="checkbox"/> Flame proof (IS-2148) <input type="checkbox"/>	
	b) Power supply	240V AC 50 Hz. <input type="checkbox"/> 110V AC 50 Hz. <input type="checkbox"/>	
5.	Mica Shield ($>400^{\circ}\text{C}$, Transparent type)	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
6.	Valve Type	Inlined <input checked="" type="checkbox"/> Offset <input type="checkbox"/>	
7.	Drain cock/valve	Cock <input type="checkbox"/> Valve <input checked="" type="checkbox"/>	
C.	CONNECTION		
1.	Type, Size & Rating		
2.	Centre to Centre distance		
3.	Nuts, bolts, gaskets for conn.	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	



DATA SHEET FOR LEVEL GAUGES

SPECIFICATION NO. :

VOLUME

SECTION

REV. NO.

DATE

SHEET

1

OF

1

Data Sheet No.: PES-145-28A-DS2-0

DATA SHEET-C

Sl. No.	Description	Data Sheet-C (To be filled in by Contractor after award of contract)	Remarks
A.	GENERAL		
1.	Manufacturer		
2.	Model Number		
3.	Tag Number		
4.	Service		
	a) Max. Operating Pressure		
	b) Max. Operating Temp.		
5.	Range		
B.	TECHNICAL		
1.	Type		
2.	Mounting		
3.	Material		
	Body		
	Ball		
	Spindle/Gland		
	Gasket		
	Glass Tube/Glass plate		
	Valves		
	Hand wheel		
	Bolt & Nuts		
	Chamber		
	Float		
4.	Illuminator		
	a) Class of protection		
	b) Flame proof (IS 2148)		
	c) Power supply		
5.	Mica Shield (>400°C, Transparent type)		
6.	Valve Type		
7.	Drain cock/valve		
C.	CONNECTION		
1.	Type, Size & Rating		
2.	Centre to Centre distance		
3.	Nuts, bolts, gaskets for conn.		



SPECIFICATION FOR LOCAL PANELS

SPECIFICATION NO.: PES – 145 – 054A

VOLUME II B

SECTION D

REV. NO. 02

DATE : 22-02-2008

1.0 SCOPE

This specification covers the Design, Manufacture, Inspection and Testing at the manufacturer's works, proper packing for transportation and delivery to site of Local Panels required for control and monitoring of the Auxiliary Plant & Equipment.

2.0 CODES AND STANDARDS

2.1 All the equipments specified herein shall comply with the requirements of the latest issue of the relevant National and International standards.

2.2 As a minimum requirement, the following standards shall be complied with:

- | | | |
|----|--------------------------|---|
| a) | IS-6005 : 1970 | : Code of practice for phosphating of iron and steel. |
| b) | IS-5 : 1978 | : Colours for ready mixed paints and enamels. |
| c) | IS-1248:1983 | : Direct Acting Indicating Instruments. |
| d) | IS-13947 (Part-III):1993 | : Rotary Cam Switches. |
| e) | IS-6875:1973 | : Auxiliary relays. |
| f) | IS-8828:1993 | : Circuit breaker for household and similar installations. |
| g) | IS-13947 (Part-I):1993 | : Low Voltage switchgear & control gear : Part-I (General Rules) |
| h) | NFPA-496:1974 | : Purged & Pressurised Enclosure for Electrical Equipment in Hazardous Locations. |

3.0 TECHNICAL REQUIREMENTS

3.1 Panel Construction

3.1.1 The local panels shall house the secondary instruments, annunciation system, Single loop controller, Control switches / push buttons, indicating lamps, relays, timers and other devices required for operation and monitoring of the equipment locally.

3.1.2 The panels shall be of free standing type either welded construction on angle iron (minimum section of 50 x 50 x 4 mm) structure or folded construction by sheet metal formation depending upon the equipments to be mounted on it. The panels shall be robustly built and stiffeners as necessary shall be provided.

3.1.3 The panel shall be suitably reinforced to ensure adequate support for all instruments mounted thereon. All welds on exposed panel surfaces shall be ground smooth.

3.1.4 The salient features of construction shall be:

Sheet material: Cold rolled sheet steel

Frame thickness: Not less than 3.0mm

Enclosure thickness: Not less than 2.5 mm for load bearing sections (Mounted with instruments),
1.6 mm for doors and Not less than 2.0 mm for others

Panel Height: Not less than 2365 mm

Gland plate thickness: 3.0mm

Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.

3.1.5 The panel shall be provided with rear doors with integral lockable handle. The door when locked shall be held at minimum three places. The door width shall not be more than 550mm. The doors shall be provided with suitable stiffeners to prevent buckling. The handle shall be on the right side of the door. The door shall be removable type with concealed hinges to facilitate maintenance work. Suitable pocket inside the door shall be provided for keeping the drawings / documents.

3.1.6 Suitable neoprene gasket shall be provided on all doors and removable covers. Suitable ventilation louvers shall be provided at bottom and top of the doors covered with removable wire mesh.



SPECIFICATION FOR LOCAL PANELS

SPECIFICATION NO.: PES – 145 – 054A

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SECTION D

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- 3.1.7 The class of protection shall be in accordance with [IP-42](#) unless otherwise specified in the data sheet – A (No. PES-145-54A-DS1-0).
- 3.1.8 All steel surfaces shall be cleaned by sand / pellet blasting, treated for pickling, degreasing and phosphating etc. by seven tank method. The panel shall have a high quality finish and appearance. The panel shall be painted with two coats of primer followed by two coats of epoxy / synthetic enamel based final paint of color shade and finish as given in data sheet-A (No. PES-145-54A-DS1-0). Minimum thickness of the paint shall be 85 microns for external paint and 70 microns for internal paint.
- 3.1.9 The cable glands of the required size and type as given in data sheet-A (No. PES-145-54A-DS1-0) shall be supplied alongwith the Panel.
- 3.1.10 All operable and indicating devices shall be mounted on the front of the panel while aux. Relays / timers MCBs etc. required for realization of control logics shall be mounted on a mounting plate inside the panel. Auxiliary relays and timers etc. shall be grouped according to the control function.
No operable or indicating devices shall be mounted below 750 mm and above 1800 mm (w.r.t. finished ground level). The devices shall be located in such a way so as to ensure easy access for operation / maintenance.
- 3.1.11 Single / dual control power supply feeders of voltage class as specified in data sheet-A (No. PES-145-54A-DS1-0) shall be provided by the purchaser. [In case redundant power supply feeders are provided then auto changeover unit shall be mounted on the panel are in the panel supplier's scope.](#) Where DC control power supply is specified an additional 240V, 50 Hz AC supply feeder for powering of space heater and lighting shall be provided by the purchaser. Suitable arrangement shall be provided inside the panel to receive and terminate the power supply feeder(s). For this purpose MCBs of suitable current rating shall be provided by the vendor. A supervisory relay along with a pilot lamp to indicate control supply 'ON' shall be provided on the panel. Any other power supply required for the operation of the devices mounted in the panel shall be arranged by the vendor.
- 3.1.12 The internal wiring shall be carried out with 1100 volt grade PVC insulated copper multi strand wire / flexible of 1.5mm² size. AC & DC wires shall be kept separate from each other. Separate coloured wires to be used for AC and DC circuits. All wires shall be properly numbered and identified with ferrules as per the Control scheme / wiring diagram. Wires shall be routed and run through PVC troughs.
- 3.1.13 Terminal blocks shall be clip on type, 1100 volts grade. Separate terminal blocks shall be used for AC & DC circuits. The terminals shall be suitable for terminating 0.5 mm² to 2.5mm² external cables. The terminal for ammeters shall be provided with removable links for shorting CTs. Each terminal strip shall be provided with identification strip. The terminal shall not be mounted below 250 mm [height from finished floor](#). The panel shall have ten (10) percent spare terminal.
- 3.1.14 The interior of each panel shall be suitably illuminated through fluorescent lamps operable on 240V 50 Hz AC power supply through panel door switch. A 15 Amp. 3-pin Power receptacle shall be provided.
- 3.1.15 Suitable space heaters operable on 240 Volts 50 Hz AC power system shall be provided at the panel bottom. These shall be designed to maintain the panel temperature five (5) deg. C above the ambient temperature during maintenance shutdown. Suitable isolating and control devices comprising of MCB, thermostat etc. shall be provided for the space heater.
- 3.1.16 The panel shall be provided with a copper earth bus of 25 x 6 mm size running throughout the width of the panel. It shall be terminated internally with 10 mm bolts at extreme ends for connection to; main station earth. The panel mounted equipments / devices shall be connected to earth bus through green coloured PVC insulated stranded copper conductor of 2.5 mm² size.
- 3.1.17 Local Panel shall be provided with main name plate of 150 mm x 40 mm size having inscription of 20 mm height. The individual devices on the panels shall be as provided with separate name plate with inscription of 3 mm height. The instrument / devices shall be provided with stick on label plates inside the panel. The material of the main and individual labels shall be three (3) ply 3 mm thick Traffolyte Sheet / 2 mm Anodised Aluminium Plate. The inscription shall be with white letters on black background on traffolyte sheet. The labels shall be fixed by self tapping non-rusting screws.



SPECIFICATION FOR LOCAL PANELS

SPECIFICATION NO.: PES – 145 – 054A

VOLUME II B

SECTION D

REV. NO. 02

DATE : 22-02-2008

3.2 Hazardous Area Panel Requirement

3.2.1 The Local Panel located in hazardous area shall be pressurized as per NFPA-496 requirements to render it non-hazardous. Alarms shall be provided for local and remote annunciation when pressurisation falls below 2.5 mm of water column. Protection shall be of type Z of NFPA-496. It shall not be possible to switch ON the power of purged section unless it is purged as per the recommendation of NFPA-496. Vendor must provide a protective device on the panel to protect the panel from over pressurisation.

3.2.2 Vendor shall supply pressurisation kit consisting of valves, restriction orifices, dual filter regulation, pressure gauges, pressure switches, rotameter etc. Pressurisation kit shall be surface mounting on a metal board and located outside the local panel. Pressurisation kit shall further consist of solenoid valve flow switch, timer blow off safety device etc., so as to make purging fully automatic. However final start shall be manual. Panel protection against over pressure to be provided as per NFPA-496.

3.2.3 Pressurised local control panel pressurization kit assembly design shall provide minimum leakage flow through the Local Control Panel. Panel venting shall be as per NFPA-496.

3.2.4 All components in the local panel like indicating instruments, push buttons switches, lamps etc., which are required to be energized without panel pressurization or before completion of purge cycle shall be explosion proof as per NEMA-7 & suitable for area classification.

3.2.5 All push buttons etc. requiring frequent operation during machine running shall have good positive sealing. Weatherproof housing or cover to be provided wherever necessary. Vendor shall provide pressurisation bypass switch outside explosion proof enclosure of pressurized panel with lamp indication. This shall be used only during maintenance. All hinges, screws, other non-painted metallic parts shall be of stainless steel material.

3.2.6 Provision to switch off manually all types of power shall be provided in the panel. In addition, it shall also be possible to switch off power circuits / components which are powered from motor control centre or control room manually in case of pressurization failure. All such cables from MCC and main control room shall be terminated in explosion proof boxes (NEMA-7).

3.3 Control & Monitoring devices

3.3.1 Instruments like Indicators, recorders, single loop controllers etc. as applicable and specified elsewhere for the plant / equipment shall be supplied and mounted on the panel.

3.3.2 Alarm Annunciator System

It shall be solid state discrete facia type having a sequence of ISA-S18.1A or as specified, opaque facia windows of 70 mm x 50 mm size, having two (2) lamps per window, and hooter of 10W, and provision for repeat group alarm at remote. The annunciator shall be provided with ten (10) percent spare windows or minimum two (2) windows along with electronics.

3.3.3 Relays

The relays shall be electromagnetic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable. There shall be ten (10) percent spare contacts.

3.3.4 Timers

The timers shall be electronic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However, minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable.

3.3.5 Control / Selector Switches

Switches shall be Rotary Cam type with minimum of 5 Amps AC & 2 Amp DC continuous current rating. Selector switches shall be stay put type while control switches shall be spring-return-to-neutral type. Contact configuration and rating shall be as per the control function requirement. The switches shall be lockable type wherever specified. Each switch shall be provided with engraved plates indicating the switch position / functions.



SPECIFICATION FOR LOCAL PANELS

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3.3.6 Push Buttons / Indicating Lights

The push buttons shall be momentary action self-resetting type, however stop P.B. for unidirectional drives shall be provided with manual reset facility. Its contact configuration & rating shall be as required for the control function but minimum 2 NO + 2 NC of 5 Amp. AC rating. It shall have round coloured projecting tab and engraved escutcheon plate / inscription plate. Colour coding of push buttons shall be as under:

RED	Motor OFF / Valve CLOSE	YELLOW	Alarm acknowledge.
GREEN	Motor ON / Valve OPEN	BLACK	Lamp test

Indicating lights shall be suitable for direct connections across specified power supplies. It shall be fitted with built in resistance to prevent circuit tripping on shorting of lamp filament. It shall be fitted with LED cluster type lamp replaceable from front.

GREEN	Motor OFF / Valve CLOSED condition	AMBER	Motor tripped condition.
RED	Motor ON / Valve OPEN condition	WHITE	Normal / healthy condition

3.3.7 Ammeters

Ammeter shall be 96 x 96 mm size, 90 deg. deflection, 1.5% accuracy, 1 Amp. CT operated or with 4-20mA input and Flush mounting type as called for in the data sheet-A (No. PES-145-54A-DS1-0). Ammeters for motors shall have six (6) times folded scale at upper end to enable motor starting current indication.

3.3.8 Miniature Circuit Breaker (MCB)

These shall be instantaneous magnetic trip type for short circuit in addition to current time inverse delayed thermal trip feature for over current protection. The housing of MCB shall be made of non-ignitable, high impact material. It shall have minimum short circuit rating of 9 KA for AC Voltages and 4 KA for DC Voltages.

3.3.9 Makes of various instruments / devices shall be as given below

1.	Alarm Annunciators	:	Procon / IIC
2.	Ammeters	:	AEP / IMP
3.	Control / Selector Switches	:	Alsthom / Kaycee / Siemens / L&T
4.	Push Buttons / Indicating Lamps	:	Siemens / L&T / Teknic / Alsthom
5.	Auxiliary Relays	:	Jyoti / Siemens / L&T / OEN
6.	Timers	:	L&T / Alsthom / Bhartiya Cutler Hammer
7.	MCBs	:	S&S Power Engg. / Indo Asian / MDS
8.	Terminal Blocks	:	Jyoti / Elmex

4.0 TESTING AND INSPECTION

4.1 The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.

4.2 BHEL's standard Quality Plan for LCP is enclosed with the specification. The bidder shall furnish his acceptance to BHEL's QP and submit the signed and stamped copy of QP along with the offer.

4.3 The vendor shall conduct the following tests as a minimum requirement:

4.3.1 Routine Tests

1. High Voltage (H.V.)
2. Insulation Resistance (I.R.)
3. Functional

4.3.2 Type Tests

1. Enclosure Class Test



SPECIFICATION FOR LOCAL PANELS

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5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

The bidder shall supply all commissioning spares and consumables 'as required' during Start-up, as part of the main equipment supply.

5.2. Mandatory Spares

The bidder shall offer alongwith main offer, the Mandatory Spares as specified elsewhere in the specification. The Mandatory Spares offered shall be of the same make and type as the main equipment.

5.3. Recommended Spares

The bidder shall furnish a list of Recommended Spares indicating the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation alongwith unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.

6.0 DRAWINGS AND DOCUMENTS

6.1 The bidder shall furnish the following documents in required number of copies along with the bid :

1. Data Sheet no. PES-145-54A-DS1-0
2. General Arrangement Drawing.
3. Catalogue and technical information for instruments and devices.
4. Quality Plan.

6.2 The vendor shall furnish the following documents in required number as agreed after the award of contract:

1. Data Shee No. PES-145-54A-DS2-0
2. GA Drawing indicating layout of instruments, construction details, foundation details, cable gland plate alongwith cable glands and all details mentioned in this specification.
3. Control Schematic Diagram along with grouping of different terminals for various functions.
4. Catalogue and technical information for instruments and devices with selected options clearly marked.
5. O&M Manuals.
6. "As Built" Drawing.
7. **CDs.**


7.0 MARKING AND PACKING


7.1 Panel with all instruments / devices mounted on it shall be suitably packed & protected for the entire period of despatch, storage and erection against impact, abrasion, corrosion, incidental damage due to vermin, sunlight, high temperature, rain moisture, humidity, dust, sea-water spray (where applicable) as well as rough handling and delays in Transit and storage in open.

8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- | | | |
|-----------------------------------|---|----------------------------------|
| - Data sheet A&B for Local Panels | : | Data sheet no. PES-145-54A-DS1-0 |
| - Data sheet C for Local Panels | : | Data sheet no. PES-145-54A-DS2-0 |

	DATA SHEET FOR LOCAL PANELS			SPECIFICATION NO.:		
				VOLUME		
				SECTION		
				REV. NO.	DATE:	
TAG No. Qty.....				Data Sheet No.: PES-145A-DS1-0		
Data Sheet A & B						
DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)				DATA SHEET-B (TO BE FILLED-UP BY BIDDER)		
GENERAL	MANUFACTURER					
	CONSTRUCTION		<input checked="" type="checkbox"/> FOLDED <input type="checkbox"/> WELDED (As per requirement)			
	ENCLOSURE SHEET THICKNESS:	FRONT	<input checked="" type="checkbox"/> 2.5 mm			
		OTHER	<input checked="" type="checkbox"/> 2.0 mm			
DOOR		<input checked="" type="checkbox"/> 1.6 mm				
TECHNICAL	INPUT POWER SUPPLY		<input checked="" type="checkbox"/> 240V 50 Hz AC <input type="checkbox"/> 220V DC <input checked="" type="checkbox"/> 415V 3 PHASE <input type="checkbox"/> (As required)			
	NO. OF FEEDERS		<input type="checkbox"/> ONE <input checked="" type="checkbox"/> TWO			
	CONTROL SUPPLY		<input type="checkbox"/> 110V AC <input checked="" type="checkbox"/> 220V AC <input type="checkbox"/> 220V DC <input type="checkbox"/> (As per requirement)			
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)		During detailed enqg NOS. (AS REQUIRED)			
	PAINT TYPE		<input type="checkbox"/> EPOXY ENAMEL <input checked="" type="checkbox"/> EPOXY POWDER COATED			
	PANEL COLOUR (EXTERNAL)		<input type="checkbox"/> LIGHT GREY (Shade 631 IS-5) During detailed enqg <input type="checkbox"/> OPALINE GREEN (Shade 275) <input type="checkbox"/>			
	FINISH		<input type="checkbox"/> MATT <input type="checkbox"/> GLOSSY <input checked="" type="checkbox"/> SEMI GLOSSY			
	PANEL COLOUR (INTERNAL)		<input checked="" type="checkbox"/> WHITE <input type="checkbox"/> CREAM <input type="checkbox"/> OFF WHITE			
	FINISH		<input type="checkbox"/> MATT <input checked="" type="checkbox"/> GLOSSY <input type="checkbox"/> SEMI GLOSSY			
	CLASS OF PROTECTION		<input type="checkbox"/> IP-42 <input checked="" type="checkbox"/> IP-54			
	CONTROL HARDWARE		<input checked="" type="checkbox"/> RELAY BASED (Whenever required)			
	FOUNDATION ARRANGEMENT		<input checked="" type="checkbox"/> FOUNDATION BOLTS <input type="checkbox"/> ANCHOR FASTENERS			
	WEIGHT OF PANEL (Kg.)					
	PANEL TYPE		<input type="checkbox"/> PRESSURISED <input checked="" type="checkbox"/> UNPRESSURISED As per Requirement			
	CABLE GLAND		<input type="checkbox"/> SINGLE COMPRESSION <input checked="" type="checkbox"/> DOUBLE COMPRESSION			
	AAMETER (TYPE OF INPUT)		<input type="checkbox"/> 1 Amp CT <input type="checkbox"/> 4-20 mA			
	NAME SIGNATURE DATE	PREPARED BY		CHECKED BY		APPROVED BY
					COMPANY SEAL	
					NAME	
					SIGNATURE	
					DATE	

	DATA SHEET FOR LOCAL PANELS			SPECIFICATION NO.:		
				VOLUME		
				SECTION		
				REV. NO.	DATE:	
TAG No. Qty.....			Data Sheet No.: PES-145A-DS1-0			
Data Sheet C						
DATA SHEET-C FOR LOCAL PANEL (TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)						
GENERAL	MANUFACTURER					
	CONSTRUCTION					
	ENCLOSURE SHEET THICKNESS	FRONT				
		OTHER				
DOOR						
TECHNICAL	INPUT POWER SUPPLY					
	NO. OF FEEDERS					
	CONTROL SUPPLY					
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)					
	PAINT TYPE					
	PANEL COLOUR (EXTERNAL)					
	FINISH					
	PANEL COLOUR (INTERNAL)					
	FINISH					
	CLASS OF PROTECTION					
	CONTROL HARDWARE					
	FOUNDATION ARRANGEMENT					
	WEIGHT OF PANEL (Kg.)					
	PANEL TYPE					
	CABLE GLAND					
	AAMETER (TYPE OF INPUT)					
	NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL NAME SIGNATURE DATE	



**TECHNICAL SPECIFICATION FOR
HYDROGEN GENERATION PLANT
2 X 800 MW NTPC GADERWARA STPP STAGE-I**

SPEC NO. PE-TS-394-168-A001

VOLUME-IIB

SECTION

REV.NO.0

DATE

SHEET

INSTRUMENTATION AND POWER SUPPLY CABLE

	INSTRUMENTATION AND POWER SUPPLY CABLE										
1.00.00	INSTRUMENTATION CABLE, POWER SUPPLY CABLE, INTERNAL WIRING AND ELECTRICAL FIELD CONSTRUCTION MATERIAL										
1.01.00	General Requirements										
1.01.01	All cables including special cables, internal wiring and electrical field construction material shall conform to this specification, Employer approved detail engineering drawings & documents and the latest edition of the relevant standards & guidelines. The Bidder shall furnish all material and services required for the completeness of the work identified in his scope as per this specification.										
1.01.02	The Contractor shall supply, erect, terminate and test all instrumentation cables for control and instrumentation equipment/devices/systems included under Contractor's scope as illustrated in the enclosed Drg. No. 0000-110-POI-A-021 and ensuring completeness of the control system.										
1.01.03	Any other application where it is felt that instrumentation cables are required due to system/operating condition requirements, are also to be provided by Contractor.										
1.01.04	Other type of cables like fiber optic/co-axial cables for system bus, cables for connection of peripherals etc. (under Contractor's scope) are also to be furnished by the Contractor.										
1.01.05	Contractor shall supply all cable erection and laying hardware from the main trunk routes like branch cable trays/sub-trays, supports, flexible conduits, cable glands, lugs, pull boxes etc. on as required basis for all the systems covered under this specification.										
1.01.06	Wherever the quantity has been defined as on as required basis, the same are to be furnished by contractor on as required basis within his quoted lump sum price without any further cost implication to the Employer.										
2.00.00	Specification of Instrumentation cable										
2.01.00	Common Requirements										
	<table border="1"> <thead> <tr> <th>S. No.</th><th>Property</th><th>Requirement</th></tr> </thead> <tbody> <tr> <td>1</td><td>Voltage grade</td><td>225 V (peak value)</td></tr> <tr> <td>2.</td><td>Codes and standard</td><td>All instrumentation cables shall comply with VDE 0815, VDE 0207, Part 4, Part 5, Part 6, VDE 0816, VDE 0472, SEN 4241475, ANSI MC 96.1, IS-8784, IS-</td></tr> </tbody> </table>	S. No.	Property	Requirement	1	Voltage grade	225 V (peak value)	2.	Codes and standard	All instrumentation cables shall comply with VDE 0815, VDE 0207, Part 4, Part 5, Part 6, VDE 0816, VDE 0472, SEN 4241475, ANSI MC 96.1, IS-8784, IS-	
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	S. No.	Property	Requirement
			10810 (latest editions) and their amendments read along with this specification.
	3.	Continuous operation suitability	At 70 deg. C for all types of cables, while 205 Deg C for Type-C cables.
	4.	Progressive automatic on-line sequential marking of length in meters	To be provided at every one meter on outer sheath.
	5.	Marking to read 'FRLS'	To be provided at every 5 meters on outer sheath except for Type-C cable.
	6.	Allowable Tolerance on overall diameter	+/- 2 mm (maximum) over the declared value in data sheet
	7.	Variation in diameter	Not more than 1.0 mm throughout the length of cable.
	8	Ovality at any cross-section	Not more than 1.0 mm
	9	Others	a) Durable marking at intervals not exceeding 625 mm shall include manufacturer's name, insulation material, conductor's size, number of pairs, voltage rating, type of cable, year of manufacturer to be provided. b) Cables shall be suitable for laying in conduits, ducts, trenches, racks and underground-buried installation c) Repaired cables shall not be acceptable.

2.02.00	Specific Requirements				
	Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
	A. Conductors				
	Cross section area	0.5 sq. mm			
	Conductor material	ANSI type KX	ANSI type SX	High conductivity Annealed bare copper	ANSI type KX
	Colour code	Yellow-Red	Black-Red	As per VDE-815	Yellow-Red
	Conductor Grade	As per ANSI MC 96.1		Electrolytic	As per ANSI MC 96.1
	No & dia of strands	7x0.3 mm (nom)			
	No. of Pairs	2	2	4,8,12,16,24,48	2
	Max. conductor resistance per Km (in ohm) at 20 deg. C	As per ANSI MC 96.1		73.4 (loop)	As per ANSI MC 96.1
	Reference Standard	As per ANSI MC 96.1		VDE 0815	As per ANSI MC 96.1
	B. Insulation				
	Material	PVC type YI 3			Teflon (i.e. extruded FEP)
	Thickness in mm (Min/Nom/Max)	0.25/0.3/0.35			0.4/0.50
	Volume Resistivity (Min) in ohm-cm	1 x 10 ¹⁴ at 20 deg. C & 1x10 ¹¹ at 70 deg. C.			---

	Voltage Rating	225 V peak operating voltage			
	Reference Standard	VDE 0207 Part 4			VDE 0207 Part 6 & ASTM D 2116.
	Core diameter above insulation	Suitable for cage clamp connector			
	C. Pairing & Twisting				
	Max. lay of pairs (mm)	50			
	Single layer of Polyester tape on each pair provided	Numbered tape	Yes	N.A.	
	Unit formation of four pairs with printing of no. of Unit provided	N.A.	Yes	N.A.	
	Conductor /pair identification as per VDE0815	N.A.	To be provided (color coding attached).	N.A.	
	D. Shielding				
	Type of shielding	Al-Mylar tape			
	Individual pair shielding	No	To be provided for F-type cable	No	
	Minimum thickness of Individual pair shielding	No	28 micron	No	
	Overall cable assembly shielding	To be provided			
	Minimum thickness of	55 micron			

	Overall cable assembly shielding			
	Shielding coverage	100% with at least 20% overlap		
	Drain wire provided for individual shield	N.A.	Yes (for F-type) 7-strand 20 AWG (0.51 mm ²) annealed Tin coated copper	N.A.
	Drain wire provided for overall shield	Yes. 7-strand 20 AWG (0.51 mm ²) annealed Tin coated copper		
	E. FILLERS			
	Non-hygroscopic, flame retardant	To be provided		
	F. Outer Sheath			
	Material	Extruded PVC compound YM1 with FRLS properties		Teflon (i.e. extruded FRP)
	Minimum Thickness at any point	1.8 mm		0.4 mm
	Nominal Thickness at any point	>1.8 mm		0.5 mm
	Color	Blue		
	Resistant to water, fungus, termite & rodent attack	Required		
	Oxygen index as per ASTMD-2863	not less than 29%		N.A.

	Temperature index as per ASTMD-2863	not less than 250 deg.C		N.A.
	acid gas generation by weight as per IEC-60754-1	Maximum 20%		N.A.
	Smoke Density Rating as per ASTMD-2843	Maximum 60% (defined as the average area under the curve when the results of smoke density test plotted on a curve indicating light absorption vs. time as per ASTMD-2843)		N.A.
	Reference standard	VDE207 Part 5		VDE207 Part 6 & ASTM D2116
	G. Electrical Parameters			
	MUTUAL CAPACITANCE BETWEEN CONDUCTORS AT 0.8 KHZ (MAX.)	200 nF/km	120 nF/km for F type 100 nF/km for G-type	200 nF/km
	INSULATION RESISTANCE (MIN)	100 M Ohm/Km		
	CROSS TALK FIGURE (MIN.) AT 0.8 KHZ	60 Db	60 dB	N.A.
	CHARACTERISTIC IMPEDANCE (MAX) AT 1 KHZ	N.A.	320 ohm for F-type 340 ohm for G-type	N.A.
	ATTENUATION	N.A.	1.2 db/km	N.A.

	<p>multi mode fibers on as required basis so as to avoid the usage of any repeaters. The core and cladding diameter shall be 9 +/- 1 micrometer and 125 +/- 1 micrometer respectively. The outer sheath shall have Flame Retardant, UV resistant properties and are to be identified with the manufacturer's name, year of manufacturer, progressive automatic sequential on-line marking of length in meters at every meter on outer sheath.</p>
3.02.00	<p>The cable core shall have suitable characteristics and strengthening for prevention of damage during pulling viz. Steel central member, Loose buffer tube design, 4 fibers per buffer tube (minimum), Interstices and buffer tubes duly filled with Thixotropic jelly etc. The cable shall be suitable for a maximum tensile force of 2000 N during installation, and once installed, a tensile force of 1000 N minimum. The compressive strength of cable shall be 3000 N minimum & crush resistance 4000 N minimum. The operating temperature shall be -20 deg. C to 70 deg.C</p>
3.03.00	<p>All testing of the fiber optic cable being supplied shall be as per the relevant IEC, EIA and other international standards.</p>
3.04.00	<p>Bidder to ensure that minimum 100% cores are kept as spares in all types of optical fibre cables.</p>
3.05.00	<p>Cables shall be suitable for laying in conduits, ducts, trenches, racks and under ground buried installation.</p>
3.06.00	<p>Spliced / Repaired cables are not acceptable.</p>
3.07.00	<p>Penetration of water resistance and impact resistance shall be as per IEC standard.</p>
4.00.00	<p>SPCIFICATION OF POWER SUPPLY CABLES</p> <p>Refer relevant subsections of this specification.</p>
5.00.00	<p>INSTRUMENTATION CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY</p> <p>The cable interconnection philosophy to be adopted shall be such that extensive grouping of signals by large scale use of field mounted Group Junction Boxes (JBs) at strategic locations (where large concentration of signals are available, e.g. valves limit & torque switches, switchgear) is done and consequently cable with higher number of pairs are extensively used. The details of termination to be followed are mentioned in the given Table A.</p>

TABLE A: CABLE TERMINATION TO BE FOLLOWED

Application		Type Of Termination		Type Of Cable
FROM (A)	TO (B)	END A	END B	
Valves/dampers drives (Integral Junction box)	Marshalling cubicle/ Marshalling cum termination Cubicle/local group JB	Plug in connector	Posts mount cage clamp type.	G
Transmitters, Process Actuated switches mounted in LIE/LIR	Integral Junction box of LIE/LIR	Plug in connector	Cage clamp (Rail mount) type.	F,G
RTD heads	Local junction box	Plug in connector	Cage clamp (Rail mount) type.	F
Thermocouple	CJC Box (if applicable)	Plug in connector	Cage clamp (Rail mount) type.	A,B,C*
Other Field Mounted Instrument	Local JB/Group JB	Plug in connector	Screwed, Cage clamp (Rail mount) type	F,G
RTD	Temperature transmitter	Plug in connector	Screwed, Cage clamp type	F
Thermocouple	Temperature transmitter	Plug in connector	Screwed, Cage clamp type	A,B,C*

	Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/Group JB/ MCC/SWGR	Group JB	Cage clamp (Rail mount) type.	Cage clamp (Rail mount) type.	F,G
	Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/Group JB/ MCC/SWGR	Marshalling Cubicle/ Marshalling cum Termination Cabinet	Cage clamp (Rail mount) type.	Posts mount cage clamp type.	F,G
	Marshalling cubicle/ Termination Cabinet	Electronic system cabinet	Cage clamp Post mounted type.	Plug in connector/Other System as per manufacturer's Standard	Internal wiring
	Marshalling/ Termination System Cabinets	UCD mounted equipments	Post mount cage clamp type.	Plug in connector/Cage clamp type (rail mounted).	F,G (with plug-in connector at one end)
	DDCMIS/PLC cabinets	PC, Printers etc.	Plug in connector	Plug in connector	Mfr.'s Standard
	<p>Notes</p> <ol style="list-style-type: none">1. Normally 10% spare cores shall be provided when the numbers of pairs of cables are more than four pairs except for pre-fabricated cables which shall be as per manufacturer's standard.2. For analog signals, individual pair shielding & overall shielding & for Binary signals, only overall shielding of instrumentation cables shall be provided.3. Also refer Drg. 0000-110-POI-A-021.4. *For high temperature applications only.5. Instrument Cabling for instruments/equipments covered under subsection MAIN EQP INST SYS shall be as per manufacturer's standard .				

6.00.00	TERMINAL BLOCKS
6.01.00	<p>All terminal blocks shall be rail mounted/post mounted, cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 deg. C. The terminal blocks in field mounted junction boxes, temperature transmitters, instrument enclosures/racks, etc., shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room logic/termination/marshalling cubicles shall be suitable for post mounted cage clamp connection at the field input end. The terminal blocks for DDCMIS input/output connections from/to SWGR/MCC, Actuators with Integral Starter (for coupling relays and check back signals of 11 kV and 3.3 kV auxiliaries, LT drives/valves & dampers/solenoids, CT & VT, etc.) shall be provided with built in test and disconnect facilities complete with plug, slide clamp, test socket etc. The exact type of terminal blocks to be provided by the Bidder and the technical details of the same including width etc. shall be subject to Employer's approval.</p>
6.02.00	<p>All the terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, partitions, small partitions, test plug bolts and test plug (as specified above for SWGR connections) transparent covers, support brackets, distance sleeves, warning label, marking, etc.</p>
6.03.00	<p>The marking on terminal strips shall correspond to the terminal numbering on wiring diagrams. For terminals catering to Employer's supplied system requirement at least 20% spare unused terminals shall be provided everywhere including local junction boxes, instrument racks/enclosures etc.</p> <p>For terminals catering to contractor's supplied system requirement at least 10% spare unused terminals shall be provided everywhere including local junction boxes, instrument racks/enclosures termination/marshalling cabinets.</p> <p>All terminal blocks shall be numbered for identification and grouped according to the function. Engraved labels shall be provided on the terminal blocks</p>
6.04.00	<p>For terminating each process actuated switches, drive actuators, control valves, Thermocouple, RTD, etc. in Local Junction Boxes, etc, refer Drg no. 0000-999-POI-A-065.</p>
6.05.00	<p>The terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal blocks and between terminal blocks and junction box walls.</p>
6.06.00	<p>For ensuring proper connections, Bidder shall provide suitable accessories, along with insulation sleeves. The exact connecting accessory shall be finalised as per application during detail engineering stage subject to Employer's approval without any cost repercussions.</p>
6.07.00	<p>Internal wiring in factory pre-wired electronic equipment cabinets may be installed according to the Bidder's standard as to wire size and method of termination or internal equipment. Terminal blocks for connection of external circuits into factory</p>

	prewired electronic equipment cabinets shall meet all the requirements as specified above.
7.00.00	INTERNAL PANELS/ SYSTEM CABINETS WIRING
7.01.00	Internal panel/cabinet wiring shall be of multi-stranded copper conductor with FRLS PVC insulation without shield and outer sheath meeting the requirements of VDE 0815.
7.02.00	Wiring to door mounted devices shall be done by 19 strand copper wire provided with adequate loop lengths of hinge wire so that multiple door opening shall not cause fatigue breaking of the conductor.
7.03.00	All internal wires shall be provided with tag and identification nos. etched on tightly fitted ferules at both ends in Employer's approved format. All wires directly connected to trip devices shall be distinguished by one additional red colour ferrule.
7.04.00	All external connection shall be made with one wire per termination point. Wires shall not be tapped or spliced between terminal points.
7.05.00	All floor slots of desk/panels/cabinets used for cable entrance shall be provided with removable gasketed gland plates and sealing material. Split type grommets shall be used for prefabricated cables.
7.06.00	All the special tools as may be required for solder less connections shall be provided by Bidder.
7.07.00	Wire sizes to be utilised for internal wiring. (i) Current (4-20 mA), low voltage signals (48V); Ammeter/Voltmeter circuit, control switches etc. for electrical system. 0.5 Sq.mm. (ii) Power supply and internal illumination. 2.5Sq.mm. minimum (shall be as per load requirement.)
8.00.00	INSTRUMENTATION CABLE INSTALLATION AND ROUTING
8.01.00	All cables assigned to a particular duct/conduit shall be grouped and pulled in simultaneously using cable grips and suitable lubricants. Cables removed from one duct/conduit shall not be reused without approval of Employer.
8.02.00	Cables shall be segregated as per IEEE Std.-422. In vertically stacked trays, the higher voltage cable shall be in higher position and instrumentation cable shall be in

	<p>bottom tier of the tray stack. The distance between instrumentation cables and those of other system shall be as follows:</p> <table><tr><td>From 11 kV/6.6 kV/3.3 kV tray system</td><td>-</td><td>914 mm</td></tr><tr><td>From 415V tray system</td><td>-</td><td>610 mm</td></tr><tr><td>From control cable tray system</td><td>-</td><td>305 mm</td></tr></table>	From 11 kV/6.6 kV/3.3 kV tray system	-	914 mm	From 415V tray system	-	610 mm	From control cable tray system	-	305 mm
From 11 kV/6.6 kV/3.3 kV tray system	-	914 mm								
From 415V tray system	-	610 mm								
From control cable tray system	-	305 mm								
8.03.00	Cables shall terminate in the enclosure through cable glands. All cable glands shall be properly gasketed. Fire proof sealing (to prevent ingress of dust entry and propagation of fire) shall be provided for all floor slots used for cable entrance. Compression cable glands (double for armoured and single for other cables) shall be provided.									
8.04.00	All cables shall be identified by tag. Nos. provided in Employer's approved format at both the ends as well as at an interval of 5 meters.									
8.05.00	Line voltage drop due to high resistance splices, terminal contacts, insulation resistance at terminal block, very long transmission line etc. shall be reduced as far as practicable.									
8.06.00	The cables emanating from redundant equipment/devices shall be routed through different paths. The above segregation of cables & wiring for redundant equipments/devices shall be in accordance with IEEE-Std-422.									
9.00.00	CABLE LAYING AND ACCESSORIES									
9.01.00	CABLE LAYING 1 CABLES SHALL BE LAID STRICTLY IN LINE WITH CABLE SCHEDULE. 2 IDENTIFICATION TAGS FOR CABLES. INDELIBLE TAGS TO BE PROVIDED AT ALL TERMINATIONS, ON BOTH SIDES OF WALL OR FLOOR CROSSING, ON EACH CONDUIT/DUCT/PIPE ENTRY/EXIT, AND AT EVERY 20 M IN CABLE TRENCH/TRAY. 3 CABLE TRAY NUMBERING AND MARKING. TO BE PROVIDED AT EVERY 10M AND AT EACH END OF CABLE WAY & BRANCH CONNECTION. 4 JOINTS FOR LESS THAN 250 METERS RUN OF CABLE SHALL NOT BE PERMITTED.									

	<p>5 BURIED CABLE PROTECTION</p> <p>WITH CONCRETE SLABS; ROUTE MARKERS AT EVERY 20 METERS ALONG THE ROUTE & AT EVERY BEND.</p> <p>6 ROAD CROSSINGS</p> <p>CABLES TO PASS THROUGH BURIED HIGH DENSITY PE PIPES ENCASED IN PCC. AT LEAST 300 MM CLEARANCE SHALL BE PROVIDED BETWEEN</p> <ul style="list-style-type: none"> - HT POWER & LT POWER CABLES, - LT POWER & LT CONTROL CABLES - LT CONTROL & INSTRUMENTATION CABLES, <p>SPACING BETWEEN CABLES OF SAME VOLTAGE GRADE SHALL BE IN ACCORDANCE WITH THE DERATING CRITERIA ADOPTED FOR CABLE SIZING.</p> <p>7 SEGREGATION (PHYSICAL ISOLATION TO PREVENT FIRE JUMPING)</p> <p>A ALL CABLE ASSOCIATED WITH THE UNIT SHALL BE SEGREGATED FROM CABLES OF OTHER UNITS.</p> <p>B INTERPLANT CABLES OF STATION AUXILIARIES AND UNIT CRITICAL DRIVES SHALL BE SEGREGATED IN SUCH A WAY THAT NOT MORE THAN HALF OF THE DRIVES ARE LOST IN CASE OF SINGLE INCIDENT OF FIRE.</p> <p>8 CABLE CLAMPING</p> <p>All cables laid on trays shall be neatly dressed up & suitably clamped/tied to the tray. For cables in trefoil formation, trefoil clamps shall be provided.</p> <p>9 Optical fiber cables inside conduit shall be laid on cable trays wherever available and feasible. In areas where the same are required to be buried, the same shall be buried in separate trench approx.1.6 meter depth, to be laid in 2" GI/rodent proof HDPE conduits covered with sand, brick and soil along the pipe line route;</p> <p>While crossing roads - to be laid in GI/rodent proof HDPE conduits with sand filling at bottom and sand, soil filling at top with cement concrete;</p> <p>While crossing canals/river- to be laid in GI/rodent proof HDPE conduits within hume pipe.</p>

9.02.00	Bidder shall supply and install all cable accessories and fittings like Light Interface Units, Surge suppressors, Opto isolators, Interface Converters, Fibre Optic Card Cage, Fibre Optic Line Driver, Repeater / Modem (for Optical Fibre Cables), cable glands, grommets, lugs, termination kits etc. on as required basis.
9.03.00	Bidder shall furnish two completely new sets of cable termination kits like Crimping tools, etc., which are required for maintenance of the system as per the type of termination used.
9.04.00	Cables, which terminate in cabinets of draw out sections shall have sufficient cable coiled in the bottom of the cabinet to permit full withdrawal of draw out sections without disconnecting the cables. When prefabricated cables with factory connectors on both ends are longer than required, the excess cable shall be coiled in the bottom of one or both termination cabinets.
9.05.00	No splices shall be made in conductors for instrument and control circuits except where required at connections to devices equipped with factory installed pigtailed. Such splices shall be made only in approved splicing boxes of fitting with removable cover. The splices shall be made with sufficient slack left in the wires to permit withdrawal of the splice from the splicing box for ease of future disconnection of the splices. All exposed conductor or connector surfaces shall be covered with a minimum of three half-lapped layers of all weather vinyl plastic electrical tape. Taping shall extend a minimum of two cable diameters over the cable jacket and a similar distance over the other insulation or connections requiring insulation.
9.06.00	The Bidder shall be responsible for proper grounding of all equipment under C&I package. Further, proper termination of cable shields shall be verified and the grounding of the same shall be coordinated so as to achieve grounding of all instrumentation cable shields at same potential. This shall be completed prior to system tests. All the cables etc. required for grounding of all equipments supplied under this package are to be supplied by the Bidder.
9.07.00	The Contractor shall take full care while laying / installing cables as recommended by cable manufacturers regarding pulling tensions and cable bends. Cables damaged in any way during installation shall be replaced at the expense of the Contractor.
10.00.00	<p>FIELD MOUNTED LOCAL JUNCTION BOXES</p> <p>(i) No. of ways 12/24/36/48/64/72/96/128 with 20% spares terminals.</p> <p>(ii) Material and Thickness 4mm thick Fiberglass Reinforced Polyester (FRP).</p> <p>(iii) Type Door gasket shall be of synthetic rubber.</p>

	<div><div>(iv)</div><div>Mounting clamps and accessories</div><div>Suitable for mounting on walls, columns, structures etc. The brackets, bolts, nuts, screws, glands and lugs required for erection shall be of brass, included in Bidders scope of supply. Raceways shall be provided inside JB's for proper termination of cables.</div></div> <div><div>(v)</div><div>Type of terminal blocks</div><div>Rail mounted cage-clamp type suitable for conductor size upto 2.5 mm². A M6 earthing stud shall be provided.</div></div> <div><div>(vi)</div><div>Protection Class</div><div>IP: 55 minimum for indoor & IP-65 minimum for outdoor applications.</div></div> <div><div>(vii)</div><div>Grounding</div><div>To be provided.</div></div> <div><div>(viii)</div><div>Color</div><div>To be decided during detailed engineering & subject to Employer's approval.</div></div>	
11.00.00	CONDUITS	
11.01.00	<p>Conduits shall be generally used for interconnecting cables from field instruments to Local JB's. All rigid conduits, couplings and elbows shall be hot dipped galvanised rigid mild steel in accordance with IS: 9537 Part-I (1980) and Part-II (1981). The conduit interior and exterior surfaces shall have continuous zinc coating with an overcoat of transparent enamel lacker or zinc chromate. Flexible conduit shall be heat resistant lead coated steel, water leak, fire and rust proof. The temperature rating of flexible conduit shall be suitable for the following areas.</p> <div><div>(i)</div><div>Mills</div></div> <div><div>(ii)</div><div>Drum</div></div> <div><div>(iii)</div><div>Main steam, RH steam</div></div> <div><div>(iv)</div><div>Air heater</div></div> <div><div>(v)</div><div>Furnace, BFP DT's</div></div> <p>And for remaining applications, water leak, fire & rust proof flexible G.I conduits shall be provided.</p>	
11.02.00	The Bidder shall install conduits according to the general routing as approved by Employer and shall coordinate conduit locations with other works.	
11.03.00	All grounding bushings within all enclosures shall be wired together and connected internally to the enclosure grounding lug or grounding bus with 8 AWG bare copper conductor. Conduit runs to individually mounted equipment shall be grounded to the Employer's cable tray grounding conductor with 12 AEG bare copper conductor. All	

	grounding bushings, clamps and connectors shall be subject to approval of the Employer.
11.04.00	All rigid conduit fittings shall conform to the requirements of IS: 2667, 1976. Galvanized steel fitting shall be used with steel conduit. All flexible conduit fittings shall be liquid tight, galvanized steel. The end fittings shall be compatible with the flexible conduit supplied.
11.05.00	All individually mounted equipment and devices shall be connected to the supply conduit, using not more than one meter of flexible conduit adjacent to the equipment or device. Flexible conduit shall be installed in all conduit runs, which are supported by both building steel and structures subject to vibration or thermal expansion. This shall include locations where conduit supported by building steel enters or becomes supported by the turbine generator foundation and where conduit supported by building steel or foundation becomes supported by steam generator framing.
11.06.00	Special areas, such as control rooms in which external noise is to be minimized, shall have flexible conduit in conduit runs where the runs cross from the main building framing to the control room framing.
11.07.00	Conduit supports shall be furnished and installed in accordance with these specifications. Support material shall comply with the following requirements. <ul style="list-style-type: none"> i) Hanger rods shall be 12 mm diameter galvanized threaded steel rods. ii) Single conduit supports shall be one-hole cast metal straps and clamp backs unless other types are acceptable to the Employer. Multiple conduit bank supports shall be constructed of special galvanized support channels with associated conduit clips.
11.08.00	Conduit sealing, explosion proof, dust proof and other types of special fittings shall be provided as required by these specifications and shall be consistent with the area and equipment with which they are installed. Fittings installed outdoors and in damp locations shall be sealed and gasketed. Hazardous area fittings and conduits sealing shall conform to NEC requirements for the area classification.
11.09.00	Contractor shall provide double locknuts on all conduit terminations not provided with threaded hubs and couplings. Water tight conduit unions and rain tight conduit hubs shall be utilised for all the application which shall be exposed to weather. Moisture pockets shall be eliminated from conduits.
11.10.00	Conduits shall be securely fastened to all boxes and cabinets.
12.00.00	CABLE SUB-TRAY & SUPPORT
12.01.00	The cable sub-trays and the supporting system, to be generally used between Local/Group JB's and the main cable trays and the same shall be furnished and

12.02.00	<p>installed by the Contractor. It is the assembly of sections and associated fittings forming a rigid structural system used to support the cable from the equipment or instrument enclosure upto the main cable trays (trunk route).</p> <p>The covers on the cable sub-trays shall be used for protection of cables in areas where damage may occur from falling objects, welding spark, corrosive environment, etc. & shall be electrically continuous and solidly grounded. The cable trays shall not have sharp edges, burrs or projections injurious to the insulation or outer sheath of the cables.</p>
12.03.00	<p>The supporting arrangement of cable tray system shall be able to withstand the weight of the cable and cable tray system. The supporting interval shall not be more than the recommended span for the above loading for the type of cable tray selected. The tray shall not overhang by more than one meter from the support at the dead end. As far as practicable the cable sub-tray system shall be supported from one side only, in order to facilitate installation and maintenance of cables.</p>
12.04.00	<p>The Bidder shall furnish and install the estimated quantities and sizes of sub trays/troughs including all required fittings and adaptors on as required basis.</p>



**TECHNICAL SPECIFICATION FOR
HYDROGEN GENERATION PLANT
2 X 800 MW NTPC GADERWARA STPP STAGE-I**

SPEC NO. PE-TS-394-168-A001

VOLUME-IIB

SECTION

REV.NO.0

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TYPE TEST REQUIREMENTS

	TYPE TEST REQUIREMENTS
1.00.00	TYPE TEST REQUIREMENTS
1.01.00	General Requirements
1.01.01	<p>The Contractor shall furnish the type test reports of all type tests as per relevant standards and codes as well as other specific tests indicated in this specification. A list of such tests are given for various equipment in table titled 'TYPE TEST REQUIREMENT FOR C&I SYSTEMS' at the end of this chapter and under the item Special Requirement for Solid State Equipments/Systems. For the balance equipment instrument, type tests may be conducted as per manufactures standard or if required by relevant standard.</p> <p>(a) Out of the tests listed, the Bidder/ sub-vendor/ manufacturer is required to conduct certain type tests specifically for this contract (and witnessed by Employer or his authorized representative) even if the same had been conducted earlier, as clearly indicated subsequently against such tests.</p> <p>(b) For the rest, submission of type test results and certificate shall be acceptable provided.</p> <p style="padding-left: 40px;">i. The same has been carried out by the Bidder/ sub-vendor on exactly the same model /rating of equipment. (For control valves, this shall be same size, type & design).</p> <p style="padding-left: 40px;">ii. There has been no change in the components from the offered equipment & tested equipment.</p> <p style="padding-left: 40px;">iii. The test has been carried out as per the latest standards alongwith amendments as on the date of Bid opening.</p> <p>(c) In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the Bidder/ sub-vendor within the quoted price and no extra cost will be payable by the Employer on this account.</p>
1.01.02	As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by the main Bidder or his authorized representative and the balance have to be approved by the Employer.
1.01.03	The schedule of conduction of type tests/ submission of reports shall be submitted and finalized during pre-award discussion.
1.01.04	For the type tests to be conducted, Contractor shall submit detailed test procedure for approval by Employer. This shall clearly specify test setup, instruments to be

1.01.05	<p>used, procedure, acceptance norms (wherever applicable), recording of different parameters, interval of recording precautions to be taken etc. for the tests to be carried out.</p> <p>The Bidder shall indicate in the relevant BPS schedule, the cost of the type test for each item only for which type tests are to be conducted specifically for this project. The cost shall only be payable after conduction of the respective type test in presence of authorize representative of Employer. If a test is waived off, then the cost shall not be payable.</p>
2.00.00	SPECIAL REQUIREMENT FOR SOLID STATE EQUIPMENTS/ SYSTEMS
2.01.00	<p>The minimum type test reports, over and above the requirements of above clause, which are to be submitted for each of the major C&I systems shall be as indicated below:</p> <ul style="list-style-type: none"> i) Surge Withstand Capability (SWC) for Solid State Equipments/ Systems <p>All solid state systems/ equipments shall be able to withstand the electrical noise and surges as encountered in actual service conditions and inherent in a power plant. All the solid state systems/ equipments shall be provided with all required protections that needs the surge withstand capability as defined in ANSI 37.90.1/ IEEE-472. Hence, all front end cards which receive external signals like Analog input & output modules, Binary input & output modules etc. including power supply, data highway, data links shall be provided with protections that meets the surge withstand capability as defined in ANSI 37.90.1/ IEEE-472. Complete details of the features incorporated in electronics systems to meet this requirement, the relevant tests carried out, the test certificates etc. shall be submitted along with the proposal. As an alternative to above, suitable class of EN 61000-4-12 which is equivalent to ANSI 37.90.1/ IEEE-472 may also be adopted for SWC test.</p> ii) Dry Heat test as per IEC-68-2-2 or equivalent. iii) Damp Heat test as per IEC-68-2-3 or equivalent. iv) Vibration test as per IEC-68-2-6 or equivalent. v) Electrostatic discharge tests as per EN 61000-4-2 or equivalent. vi) Radio frequency immunity test as per EN 61000-4-6 or equivalent. vii) Electromagnetic Field immunity as per EN 61000-4-3 or equivalent. <p>Test listed at item no. v, vi, vii, above are applicable for electronic cards only as defined under item (i) above.</p>

3.00.00	TYPE TEST REQUIREMENT FOR C&I SYSTEMS					
	Sl. No	Item	Test Requirement	Standard	Test To Be Specifically Conducted	NTPC's Approval Req. On Test Certificate
	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6
	1	Elect. Metering instruments	As per standard (col 4)	IS-1248	No	Yes
	2	Thermocouple	Degree of protection test	IS-2147	No	No
	3	CJC Box	Degree of protection test	IS-2147	No	No
	4	RTD	As per standard (col 4)	IEC-60751	No	No
	5	Electronic transmitter	As per standard (col 4)	BS-6447 / IEC-60770	No	Yes
	6	E/P converter	As per standard (col 4)	Mfr. standard	No	Yes
	7	Instrumentation Cables Twisted & Shielded (Refer Note-B below)				
		-Conductor	Resistance test	VDE-0815	No	Yes
			Diameter test	IS-10810	No	Yes
			Tin Coating test (Persulphate test)	IS-8130	No	Yes
		-Insulation	Loss of	VDE 0472	No	Yes

		mass			
		Ageing in air ovens**	VDE 0472	No	Yes
		Tensile strength and elongation test before and after ageing**	VDE 0472	No	Yes
		Heat shock	VDE 0472	No	Yes
		Hot deformation	VDE 0472	No	Yes
		Shrinkage	VDE 0472	No	Yes
		Bleeding & blooming	IS-10810	No	Yes
	-Inner sheath***	Loss of mass	VDE 0472	No	Yes
		Heat shock	VDE 0472	No	Yes
		Cold bend/ cold impact test	VDE 0472	No	Yes
		Hot deformation	VDE 0472	No	Yes
		Shrinkage	VDE 0472	No	Yes
	-Outer sheath	Loss of mass	VDE 0472	No	Yes
		Ageing in air ovens**	VDE 0472	No	Yes
		Tensile strength and elongation test before and after	VDE 0472	No	Yes

		ageing**			
		Heat shock	VDE 0472	No	Yes
		Hot deformation	VDE 0472	No	Yes
		Shrinkage	VDE 0472	No	Yes
		Bleeding & blooming	IS-10810	No	Yes
		Colour fastness to water	IS-5831	No	Yes
		Cold bend/ cold impact test	VDE-0472	No	Yes
		Oxygen index test	ASTMD-2863	No	Yes
		Smoke Density Test	ASTMD-2843	No	Yes
		Acid gas generation test	IEC-60754-1	No	Yes
	-fillers	Oxygen index test	ASTMD-2863	No	Yes
		Acid gas generation test	IEC-60754-1	No	Yes
	-AL-MYLAR shield	Continuity test		No	Yes
		Shield thickness		No	Yes
		Overlap test		No	Yes
	-Over all cable	Flammability Test	IEEE 383	No	Yes

		Swedish Chimney Test	SEN 4241475	No	Yes
		Noise interference	IEEE Transactions	No	Yes
		Dimensional checks	IS 10810	No	Yes
		Cross talk	VDE-0472	No	Yes
		Mutual capacitance	VDE-0472	No	Yes
		HV test	VDE-0815	No	Yes
		Drain wire continuity		No	Yes
	* For Drain wire only				
	**These tests shall be carried out as per VDE0207 Part 6 & ASTM D-2116 for TEFLON insulated & outer sheathed cables				
	***Applicable for armoured cables only				
	8	DC Power Supply System The Type Test Reports for offered rectifier module and controller module irrespective of the rectifier bank rating shall be acceptable.			
		Degree of Protection	IS-13947 or equivalent	No	Yes
		Dry Heat Test	IEC-68-2-2 or equivalent	No	Yes
		Damp Heat test	IEC-68-2-3 or equivalent	No	Yes
		Vibration test	IEC68-2-6 or equivalent	No	Yes

		Electromagnetic field immunity	EN 61000-4-3 or equivalent	No	Yes
		Electrostatic discharge test	EN 61000-4-2 or equivalent	No	Yes
		Radio frequency immunity test	EN-61000-4-3 or equivalent	No	Yes
9	Battery (Refer Note-A below)	As per standard (col 4)	IS-10918	No	Yes
10	Voltage Stabiliser	Over Load Test	Approved procedure	No	Yes
		Temp rise test without redundant fans	Approved procedure	No	Yes
		Input voltage variation test	Approved procedure	No	Yes
11	DDCMIS				
	CLCS Systems	Model test	Approved procedure	No	No
	BMS	Safety requirements	VDE0116 Sec 8.7	No	Yes
12	Conductivity Type Level Switch	Degree of protection test	IS-2147	No	No
13	Local Gauges	Degree of protection test	IS-2147	No	No

14	Process actuated Switches	Degree of protection test	IS-2147	No	No
15	Control Valves	CV test	ISA 75.02	No	Yes
16	PLCs	As per standard (Col 4)	IEC 1131	No	No
17	LIE / LIR	Degree of protection test	IS-2147	No	Yes
18	Flue gas O2 analyser, other Flue Gas analysers	Degree of protection test	IS-2147	No	Yes
19	Flow Nozzles & Orifice plates	Calibration	ASME PTC BS 1042	No	Yes

Note:

Type Tests are to be conducted only for the items, which are being supplied as a part of this Package.

A. For batteries with electric power supply system of TG C&I, the contractor shall submit for Employer's approval the reports of all the type tests as per IS-10918 carried out within last five years from the date of bid opening and the tests should have been either conducted at an independent laboratory or should have been witnessed by a client. The complete type test reports shall be for any rating of battery in a particular group, based on plate dimensions being manufactured by supplier.

For batteries with electric power supply system of auxiliary plants, type test reports for batteries shall be as per standard practice of manufacturer.

B. All cables to be supplied shall be of type tested quality. The Contractor shall submit for Employer's approval the reports of all the type tests pertaining to cables as listed in this specification and carried out within last five years from the date of bid opening. These reports should be for the tests conducted on the cables similar to those proposed to be supplied under this contract and

	<p>the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.</p> <p>In case the Contractor is not able to submit report of the type test(s) for cables conducted within last five years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract free of cost to the Employer and submit the reports for approval.</p>



**TECHNICAL SPECIFICATION FOR
HYDROGEN GENERATION PLANT
2 X 800 MW NTPC GADERWARA STPP STAGE-I**

SPEC NO. PE-TS-394-168-A001

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SECTION

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PROCESS PIPING AND CONNECTION

	PROCESS CONNECTION AND PIPING
1.00.00	PROCESS CONNECTION PIPING
1.01.00	The Contractor shall provide, install and test all required material for completeness of Impulse Piping System and Air Piping System as per the requirements of this Sub-section, enclosed installation drawings and source connection drawings on as required basis for the connection of instruments and control equipment (provided by the Contractor) to the process / Employer's main equipment / systems. The installation & source connection of various items shall generally as per installation drawings (drawing no. 0000- 110 -POI-A-022 to 033, 0000- 110 -POI-A-034) and instrument source connection drawings (drawing nos. 0000-110 -POI-A -035), however, the Contractor shall furnish during detailed engineering. Installation drawings, GA and fabrication drawings of LIES / LIRs, other relevant drawings, material and tech data sheets of various items service wise for Employer's approval / information.
1.01.01	All materials, furnished under this sub-section and the installation thereof shall conform to the latest editions of American National Standard Code for Pressure Piping, Power Piping, ANSI B 31.1, ANSI B16.11, ASME Boiler and Pressure Vessel Codes, IBR and other applicable ASME, ANSI and state standards.
1.01.02	All materials supplied under this Sub-section shall be suitable for intended service, process; operating conditions and type of instruments used and shall fully conform to the requirements of this specification. The bidder is responsible for the performance of equipment furnished under this specification on system basis. The Bidder may offer suggestions for improvement based on his experience, during detailed engineering, which shall be subjected to the Employer's approval.
1.01.03	Contractor to note that any reducers, nipple etc. for proper connection of the impulse piping system to Employer's root valves / isolation valves / stubs etc. shall be in Contractor's scope only, unless otherwise clearly excluded.
1.02.00	IMPULSE PIPING, TUBING, FITTINGS, VALVES AND VALVE MANIFOLDS
1.02.01	All impulse pipe shall be of seamless type conforming to ANSI B36.10 for schedule numbers, sizes and dimensions etc. The material of the impulse pipe shall be same as that of main process pipe. For various applications specification of impulse pipe materials and associated fittings and valves shall be as given in Table PCP. For protection against sea environment, all impulse pipes, fittings etc shall be provided with durable epoxy coating with poly urethane finish.
1.02.02	Stainless steel tube shall be provided inside enclosures & racks from tee connection to valve manifold and then to instrument. For high pressure/temperature applications (piping class A,B,C & D of the table no. PCP) the material shall be ASTM A 213 TP

	316H it and for other applications material shall be ASTM A 213 TP 316L. The wall thickness of the tube shall be in accordance with the ANSI B31.1 standard. The bending radius of the tube shall be greater than 6D.
1.02.03	All fittings shall be forged steel and shall conform to ANSI B16.11. The material of forged tube fittings for shaped application (e.g. Tee, elbow etc.) shall be ASTM A 182 Gr. 316 H for high pressure/ temperature applications (as defined above) and ASTM A 182 Gr. 316L for other applications. The material for bar stock tube fitting (for straight application) shall be 316 SS. Metal thickness in the fittings shall be adequate to provide actual bursting strength equal to or greater than those of the impulse pipe or SS tube, with which they are to be used.
1.02.04	The source shut-off (primary process root valve) and blow down valve shall be of 1/2 inch size globe valve type for all applications except for air and flue gas service wherein no source shut-off valves are to be provided. For various applications the valve body material, stem material and pressure class shall be as given in Table PCP. The end connections of valves shall be of socket welded type unless otherwise specified in the instrument installation diagrams. The disc and seat ring materials of carbon steel and alloy steel valves shall be ASTM A-105 and ASTM A-182, Gr. F22, hard faced with stellite (minimum hardness - 350 BHN.) The surface finish of 16 RMS or greater is required in the area of stem packing. The valve design shall be such that the seats can be reconditioned and stem and disc may be replaced without removing the valve body from the line.
1.02.05	The valve manifolds shall be of 316 stainless steel with pressure rating suitable for intended application. 2-valve manifold and 3-valve manifold shall be used for pressure measurements using pressure transmitters/ pressure switches and differential pressure transmitter/ switches respectively. 5-valve manifold shall be used for remaining applications like DP, flow and level measurements.
1.02.06	For Pr./D.P gauges in fluid application two-way globe valve on each impulse line to the instrument and in Air / Flue gas application two-way gate valve on each impulse line to the instrument shall be provided near the instrument. These shall be in addition to the three ways gauge cock provided along with the pr./D.P gauges.
2.00.00	AIR SUPPLY PIPING
2.01.00	All pneumatic piping, fittings, valves, air filter cum regulator, purge Rotameter and other accessories required for instrument air for the various pneumatic devices/ instruments shall be provided. This will include as a minimum air supply to pneumatically operated control valves, actuators, instruments, continuous and intermittent purging requirements etc.
2.02.00	Instrument air supply shall be provided for continuous purging requirements of local instrument enclosures (LIEs) and any other instrument supplied by the Contractor

	<p>which requires instrument air. Also for intermittent purging requirements of local instrument enclosures (LIEs) all pipings, fittings valves etc. shall be provided for service air supply to LIEs housing air and flue gas transmitters. Service air supply shall also be provided for any other instrument supplied by the contractor requiring service air. The contractor shall also provide and connect pneumatic tubing to E/P convertors and then to control valves supplied by the Employer but controlled by the C&I Contractor.</p>
2.03.00	<p>For individual supply line and control signal line to control valve, 1/4-inch size light drawn tempered copper tubing conforming to ASTM B75 shall be used. The thickness of cu-tubing shall not be less than 0.065 inch and shall be PVC coated. The fittings to be used with copper tubes shall be of cast brass, screwed type.</p>
2.04.00	<p>All other air supply lines of 1/2 inch to 2 inch shall be of mild steel hot dipped galvanized inside and outside as per IS-1239, heavy duty with threaded ends. The threads shall be as per ASA B2.1. Fittings material shall be of forged carbon steel A234 Gr. WPB galvanized inside and outside, screwed as per ASA B2.1. Dimensions of fittings shall be as per ASA B16.11 of rating 3000 lbs.</p>
2.05.00	<p>The Employer shall provide instrument air at two points for the boiler area and one point for the turbine area at a convenient point for each unit. Similarly the Employer shall provide service air also at two points for the boiler area and one point for the turbine area at a convenient point for each unit. For air supply to various devices mentioned above, the contractor shall provide 2 inch size GI pipe header with isolation valve from the instrument air and service air terminal points. In the boiler area the 2 inch head shall be provided upto top most elevation of boiler floor and from this 2 inch header, 1 inch sub-header shall be branched off at each floor with isolation valve. From this 1 inch sub-header, branch line of 1/2 inch, with isolation valve shall be provided upto various devices. In the Turbine area the 2 inch head shall be provided upto top most elevation of Turbine floor and from this 2 inch header, 1 inch sub-header shall be branched off at each floor with isolation valve. From this 1 inch sub-header, branch line of 1/2 inch, with isolation valve shall be provided upto various devices. Similar system is to be followed for service air required for intermittent purging in the Local Instrument Enclosures (LIEs) etc.</p>
2.06.00	<p>All instrument air filters cum regulator set with mounting accessories shall be provided for each pneumatic device requiring air supply. The filter regulators shall be suitable for 10-kg/ sq.cm max. Inlet pressure. The filter shall be of size 5 microns and of material sintered bronze. The air set shall have 2-inch size pressure gauge and built in filter housing blow down valve. The end connection shall be 1/4 inch / 1/2 inch / 3/4 inch NPT as per the requirement to be finalised during detailed engineering.</p>
2.07.00	<p>All the isolation valves in the air supply line shall be gate valves as per ASTM B62 inside screw rising stem, screwed female ends as per ASA B2.1. Valve bonnet shall</p>

2.08.00	<p>be union type & trim material shall be stainless steel, body rating 150 pounds ASA. The valve sizes shall be ½ inch to 2 inch.</p> <p>Purge Air Connection for Air and Flue gas Applications</p> <p>The continuous purging with instrument air shall be done, for all air and flue gas measurements, at the process source connection end. Necessary arrangements required for continuous purging shall be provided inside all instrument enclosures and instrument racks for Air and Flue gas applications as per enclosed drawing no. 0000-999-POI-A-034.</p> <p>For intermittent purging with service air, necessary arrangements inside all the air and Flue gas enclosures shall be provided as per drawing no. 0000-110-POI-A-034. The SS four ways valve provided in the SS tubing shall be used for isolating the transmitter & connecting the service air quick disconnect line.</p> <p>Purging arrangement is not required for Instrument air and service air measurement applications.</p> <p>Purge air lines shall be of mild steel hot dipped galvanized inside and outside as per IS1239, heavy duty with threaded ends.</p>
3.00.00	INSTALLATION AND ROUTING
3.01.00	All instrument piping, tubing and its accessories shall be supported in a safe manner to prevent excessive vibrations and anchored sufficiently to prevent undue strain on connected equipment. Instrument piping & tubing shall not be routed across equipment removal areas, above or below monorails, cranes, removable gratings, cable trays.
3.02.00	Instrument Piping System
3.02.01	For steam and liquid measurements, the impulse pipe should preferably slope downward from source connection to instrument and instrument shall be installed below the source point. If due to any reason instrument is installed above the source point, the impulse pipe should slope upwards continuously and a 'pigtail' should be provided at the instrument to assure water seal for temperature protection. For vacuum measurements instrument shall be installed above source point and impulse pipe should slope upwards.
3.02.02	Impulse piping for air and flue gas shall slope upwards and instrument shall be installed above source point. If this requirement cannot be met special venting or drain provision shall be provided with vent & drain lines alongwith isolation valves and other accessories including drainpipes. This drain is to be connected to plant drain through open funnel also. Horizontal runs must have a slope of not less than

	40 mm per meter and must be adequately supported to maintain a constant slope and to prevent sag in piping.
3.02.03	All impulse piping shall be installed to permit free movement due to thermal expansion. Wherever required expansion loops shall be provided.
3.02.04	Special accessories such as condensing pots/ reservoirs shall be provided and installed wherever required. In any case condensing pots shall be provided for all level measurements in steam and water services, all flow measurement in steam services and flow measurements water services above 120 Deg. C. For drum level measurement required balancing chamber shall be provided and installed.
3.02.05	Colour coding of all impulse pipes shall be done by the Contractor in line with the colour coding being followed for the parent pipes.
3.03.00	Instrument Air & Service Air Piping/ Tubing System
3.03.01	The air supply headers, sub-headers and branch pipes shall be supported properly by clamps or supports to be provided and fabricated by the Contractor. Air supply piping shall be installed with a slope of over 1/100 to prevent accumulation of condensed water within the pipe. Signal/control air tubing shall run with the minimum number of changes in direction. Suitable identification tags shall be provided for easy link up and checking of proper connections. Single and multi tubes shall run with the minimum number of changes in direction. Suitable identification tags shall be provided for easy checkup and for connections.
4.00.00	PIPING/TUBING SUPPORT Impulse piping and sample piping shall be supported at an interval not exceeding 1.5 meters. Each pipe shall be supported individually using slotted angle mounted clamps with necessary fixtures. Tubing shall run in proper perforated trays with proper cover. Tubing shall be supported inside the trays by aluminium supports. Hangers and other fixtures required for support of piping and trays shall be provided, either by welding or by bolting on walls, ceilings and structures. Hanger clamps and other fastening hardware shall be of corrosion resistant metals and hot-dip galvanized.
5.00.00	SHOP AND SITE TESTS
5.01.00	General Requirements
5.01.01	The equipment and work performed as per this Sub-section shall be subject to shop and site test as per requirements of Sub-section-IIIE-04 (Quality Assurance & Inspection) other applicable clauses of this Sub-section and Employer approved quality assurance plan.

5.01.02	Hydrostatic and pneumatic tests shall be performed on all pipes, tubing and systems and shall conform to ANSI B31.1.
5.02.00	Hydrostatic Testing
5.02.00	<p>All instrument piping/ tubing shall be hydrostatically tested upon completion of erection. The test pressure shall be 1.5 times the maximum process pressure. The test shall be performed either with the testing of associated process piping or without the associated process piping (by closing the root valve). In both the cases the instrument shall be isolated by closing the shut-off valve.</p>
5.02.00	<p>Air Testing</p> <p>All air headers & branch pipes shall be air tested by pressure decay method as per ANSI B31.1. Flexible hoses and short signal tubing shall be tested at normal pressure for leakage. Long signal tubing shall be tested by charging each tube with air at 2 kg/ sq. cm. through a bubbler sight glass. The boiler draft and vacuum piping shall be air tested by the same method as long signal tubing.</p>
6.00.00	<p>LOCAL INSTRUMENT ENCLOSURE AND RACKS</p> <div> <p>The internal layout shall be such that the impulse piping/ blow down lines are accessible from back side of the enclosure / rack and the transmitters etc. are accessible from front side for easy maintenance. Bulkheads, especially designed to provide isolation from process line vibration shall be installed on instrument enclosures/racks to meet the process sensing line connection requirement.</p> <p>Vibration dampeners shall be installed for each enclosure / rack.</p> </div> <div> <p>The enclosures shall be constructed of 1.6 mm sheet plate and shall be of modular construction with one or more modules and two end assemblies bolted together to form an enclosure. Channel and frame shall be 3 mm thick. Double inter locking doors shall be provided. The doors shall be the three-point locking type constructed of not less than 1.6 mm thick steel. Doors shall have concealed quick removal type pinned hinges and locking handles. Door locks shall accept the same key.</p> <p>Gaskets shall be used between all mating sections to achieve protection class of IP-55.</p> </div> <div> <p>The instrument racks shall be free standing type constructed of suitable 3 mm thick channel frame of steel and shall be provided with a canopy to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel, and extended beyond the ends of the rack. Bulk heads, especially designed to provide isolation from process line vibration shall be provided. Exact fabrication details shall be as finalised during detailed engineering stage. The junction box for racks also shall conform to IP 55 protection class.</p> </div>

	<p>Enclosures/racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein. Centre posts or any member which would reduce access shall not be provided.</p> <p>Each transmitter enclosure housing instruments requiring purge air for continuous air purging, shall be provided with common purge air header, redundant air filter regulators of sufficient capacity, required pressure gauges, valves, fittings, SS tubings and individual purge meters for each purge line etc. as required and indicated in Instrument Installation drawings enclosed herewith.</p> <p>A 15 mm NB service air header shall be furnished in each instrument enclosure housing air & flue gas and coal mill instruments. The header shall be furnished complete with a pressure regulating valve, pressure gauge, and quick disconnect connections. A hose for connecting each header to the draft instrument line four-way valves shall be furnished. The hose shall be self-storing nylon tubing having a burst pressure of 15 kg/sq.cm. The size of the hose shall be 1/2" minimum. The service air header shall originate at a bulkhead penetration or fitting located on one of the bulkhead plates.</p> <p>The contractor shall prepare the piping drawings and the general arrangement layout drawings for each of the enclosures and racks. Special attention shall be given in the piping layout to avoid air traps in liquid filled piping or water pockets in piping intended to be dry. Drawings shall indicate the arrangement of all equipment, piping, valves and fittings within, the enclosure/racks and shall be subject to Employer's approval.</p> <p>All liquid filled blow down lines, except those measuring vacuum shall be connected to a two inch header which is extended through one end of the enclosure and turned downward for directing the blow down into a drain. The material of the blow down header shall be carbon steel as per ASTM A 106 Gr C.</p> <p>The Contractor shall submit to the Employer with his proposal a copy of his welding procedure specification together with proof of his compliance with the latest applicable welding ANSI code. Prior to any welding being performed, the Contractor shall submit the qualifications of the craftsmen who will perform the work.</p>

TECHNICAL REQUIREMENTS

7.00.0 TABLE PCP

System/Line Description	Piping Class	Impulse Material	Pipe	Schedule (Size)	Materials for Fitting/Valve Body	Valve Stem Material	Rating of Piping/ Fittings	Pr. Class of Valve
Main Steam/ Upstream of HP bypass and Auxiliary Steam Pressure reducing valve, Drum Level	A	ASTM-A335 Gr.P-91/22 (Note-2)		XXS (1/2 inch)	(Note-3)	(Note-3)	9000 lb	3000 SPL
BFP disch, superheater attemperator, spray to PRDS, Phosphate dosing pp disch, BCW pump	B	ASTM-A106 Gr. C		160 (1/2 inch)	ASTM-A105	ASTM-A-182 Gr.F6a	6000 lb	2500
Reheater attemperator	C	ASTM-A106 Gr. C		160 (1/2 inch)	ASTM-A105	-do-	6000 lb	1500
Hot Reheat/ down stream of Aux. Steam press. Reducing valve upto desuper heater/ Flash tank drain manifold, HP heater level.	D	ASTM-A335 Gr. P-91/22 (Note-2)		160 (1/2 inch)	ASTM-A182 Gr.F-22	(Note-3)	3000 lb	900
Cold reheat upto Tee-off for HP Bypass / Extraction steam to HPH	E	ASTM-A335 Gr.P-22		80 (1/2 inch)	ASTM-A182 Gr.F-22	ASTM-A-182 Gr.F6a	3000 lb	800
Cold reheat down steam of Tee-off (HP Bypass)	F	ASTM-A106 Gr. C		80 (1/2 inch)	ASTM-A105	-do-	3000 lb	800
BFP suction, Condensate System/ Extraction to LPH/ Ext-4 to BFPT, Deaerator/ auxiliary steam, service air, inst air, ECW pump, ACW pump and other low pr water services	G	ASTM-A106 Gr. B		80 (1/2 inch)	ASTM-A105	-do-	3000 lb	800
Air/ Flue gas outside furnace	M	ASTM-A106 Gr. B/C		80 (3/4 inch)	ASTM-A105	-do-	3000 lb	800
Air/ Flue gas inside furnace	N	ASTM-A335 Gr.P22		80 (3/4 inch)	ASTM-A182 Gr. F-22	-do-	3000 lb	800
NOTE:								
1	Rating of piping/fittings/valves etc. is subjected to the final design pressure & temperature during the detailed engineering.							
2	In case temperature is more than 540 deg C, the material shall be P-91 only.							
3	Material shall be compatible with that of the impulse pipe material and design parameter.							
4	Separator related impulse piping material shall be as per main process pipe/tank material							



**TECHNICAL SPECIFICATION FOR
HYDROGEN GENERATION PLANT
2 X 800 MW NTPC GADERWARA STPP STAGE-I**

SPEC NO. PE-TS-394-168-A001

VOLUME-III

SECTION

REV.NO.0

DATE

SHEET

VOLUME-III

SCHEDULE OF DEVIATIONS

(All deviations from the Technical Specification shall be filled in by the BIDDER clause by clause in this schedule)



**TECHNICAL SPECIFICATION FOR
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S. No.	Volume / Section	Page No.	Clause No.	Technical Specification	Deviation	Cost of withdrawal (**)

(**) Bidder to note the following:

- Bidder shall indicate "quoted" in cost of withdrawal column of schedule of technical deviation along with their technical offer.
- Bidder shall furnish priced schedule of technical deviation along with price bid in sealed envelope.
- Cost of withdrawal prices shall be submitted without taxes, duties, freight and other taxes as applicable for project.