

**PATRATU VIDYUT UTPADAN NIGAM LIMITED
(PVUNL)**

3X800MW PATRATU TPP PHASE-1

VOLUME – II B

**TECHNICAL SPECIFICATION
FOR
HYDROGEN GENERATION PLANT**

SPECIFICATION NO. PE-TS-434-168-A001, R0



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, INDIA**



TITLE :
3X800MW PATRATU TPP PHASE-1

SPECIFICATION NO. PE-TS-434-168-A001

SECTION :

**TECHNICAL SPECIFICATION FOR HYDROGEN
GENERATION PLANT**

REV. NO. 00

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	एनटीपीसी NTPC PATRATU STPS EXPANSION PHASE-I (3X800 MW)															
1.00.00	BACKGROUND A Memorandum of Agreement (MOA) has been entered on 29.07.2015 amongst Govt. of Jharkhand (GoJ), Jharkhand Urja Vikash Nigam Limited (JUVNL), Jharkhand UrjaUtpadan Nigam Limited (JUUNL), Jharkhand BijliVitaran Nigam Limited (JBVNL) and NTPC Limited to form a Joint Venture Company of NTPC Limited& JBVNL for transfer of Patratu Thermal Power Station (PTPS) located in Ramgarh District of Jharkhand State to the proposed JV Company for Performance Improvement of existing capacity & 4000 MW Capacity expansion of PTPS. Further to signing of JV agreement on 29.07.2015, a Joint Venture Company namely Patratu Vidyut Utpadan Nigam Limited (PVUNL) has been incorporated amongst GoJ, JUVNL, JBVNL and NTPC Ltd. on 15.10.2015. The Performance Improvement of existing capacity and 4000 MW Capacity expansion of Patratu STPS will be implemented by the JV Company (JVC). The configuration of expansion of 4000 MW shall consist of 5 units of 800 MW to be implemented in two phases; Phase-I: 3x800 MW and Phase-II: 2x800 MW. The present proposal is for Patratu STPS Phase-I (3x800 MW). The project is envisaged to be commissioned during XIII Plan period.															
2.00.00	CAPACITY Patratu STPS Phase-I: 3x800 MW - Present proposal															
3.00.00	MODE OF OPERATION Base Load															
4.00.00	LOCATION AND APPROACH															
4.01.00	Patratu Thermal Power station (PTPS) is located just outside the coal belt of South Karanpura in Ramgarh District of Jharkhand State. The nearest Railway Station is Patratu which is at a distance of about 4 km on Barkakhana-Barwadih Railway line.															
4.02.00	The latitudes and longitudes of the site are as follows: <table><tr><th>Corner name</th><th>Latitude</th><th>Longitude</th></tr><tr><td>Top Corner</td><td>23° 38 ' 60 " N</td><td>85° 17' 51.5" E</td></tr><tr><td>Bottom Corner</td><td>23° 38 ' 12.5 " N</td><td>85° 17' 27" E</td></tr><tr><td>Left Corner</td><td>23° 38 ' 22.5 " N</td><td>85° 17' 10.6 " E</td></tr><tr><td>Right Corner</td><td>23° 38 ' 40 " N</td><td>85° 17' 57 " E</td></tr></table>	Corner name	Latitude	Longitude	Top Corner	23° 38 ' 60 " N	85° 17' 51.5" E	Bottom Corner	23° 38 ' 12.5 " N	85° 17' 27" E	Left Corner	23° 38 ' 22.5 " N	85° 17' 10.6 " E	Right Corner	23° 38 ' 40 " N	85° 17' 57 " E
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4.03.00	Airport The nearest commercial airport is Ranchi at about 45 km by road.															



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	A copy of Vicinity plan of the project site is placed at Annexure - I .	
5.00.00	LAND The total land to be transferred to JV Company is 1859 acres. Out of 1859 acre, about 1234 acres of land has been envisaged for Plant, Ash pond and Land on railway track of the for Phase-I (3x800 MW). The balance 625 acre of land shall be transferred during commencement of Phase-II (2x800 MW).	
6.00.00	WATER The make-up water for PSTPS is to be met from Patratu Dam on Nalkari River (capacity 99 MCM i.e. 110 Cusecs). About 52.34 Cusecs of water will be available at 90% dependable monsoon flow after considering evaporation loss. GoJ/JUVNL owns and controls water of Patratu Dam. GoJ/JUUNL supplies water to PTPS and to the other entities in the vicinity from this water reservoir. JUVNL had entered into agreements with these other entities for supply of water from water reservoir. JUVNL shall revisit these agreements to meet the requirement of water for expansion projects, if required. Make up water requirement of PSTPS, Phase-I (3x800 MW) would be about 27 Cusecs with "Air Cooled Condenser" based power plant. GoJ shall provide the required water from the existing reservoir to the JV Company. The JVC shall be responsible for the water supply arrangement starting at the downstream of intake chamber from where water supply commences for the Station. Ownership of the entire water supply system and related plant and equipment, including the water treatment plant, shall be that of the JVC and after the asset transfer, the JVC shall maintain, take care and use the same. The additional facility including addition of plant, equipment etc. for enhanced requirement (if any) and drawl of water shall be the responsibility of JVC and to be arranged by the JVC at their own cost.	



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7.00.00	COAL	
7.01.00	Coal Requirement, Availability and Linkage About 12 MTPA of coal will be required to meet coal requirement of the Phase-I (3x800 MW) of the project. The Banhardih captive coal block at a distance of about 155 km from plant is allocated to JUVNL for end use of Patratu expansion. The coal from Banhardih captive coal block shall be transferred to the JVC for the usage of PSTPS with the approval of Ministry of Coal, GOI. MOC (11.09.15) has accorded in-principle approval of the Central Govt. to assign Banhardih Coal Block allocated to JUVNL to the JV Company.	
7.02.00	Coal Transportation The envisaged mode of coal transportation from the coal mines to the power plant is by Indian Railways through BOBR / BOX- N wagons.	
7.03.00	Coal Quality The primary fuel for the main steam generator shall be coal. The domestic coal quality parameters are indicated in Annexure-IV-2 and imported coal parameters are indicated in Annexure-IV-4 are to be considered for steam generator design.	
7.04.00	Fuel Oil The fuel oils to be used for start-up, coal flame stabilization and low load operation of the steam generator shall be Heavy Fuel Oils having the characteristics given at Annexure-IV-3 and Light Diesel Oil having the characteristics given at Annexure-IV-1.	
8.00.00	NOT USED	
9.00.00	STEAM GENERATOR TECHNOLOGY The steam generators shall be super critical once through type, water tube, direct pulverized coal fired, top supported, balanced draft furnace, single reheat, radiant, dry bottom type, suitable for outdoor installation. The gas path arrangement shall be single pass (Tower type) or two pass type.	
10.00.00	FLUE GAS DESULPHURIZATION SYSTEM (FGD) & SCR: The project is envisaged with Flue Gas Desulfurization (FGD) system and SCR meeting Ministry of Environment, Forest & Climate Change notification dated 07.12.2015. Limestone to be used for design of FGD system shall be as per the characteristic given at Annexure-IV-5.	
11.00.00	POWER EVACUATION SYSTEM 85% of power from the project is envisaged to be allocated to Jharkhand State subject to approval of Ministry of Power, while balance 15% would be as unallocated portion and Project is envisaged as regional project. Since major power (85%) is proposed to be absorbed by Jharkhand, the issue of Associated Transmission	



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	System for the project would be taken up with them for planning and execution of transmission system modalities as Inter-State System or ISTS System. Considering overall capacity of the project as 4000 MW, 765 kV step-up system has been envisaged. Two D/C 765 KV line, one each to New Ranchi (Bero) and Gaya has been envisaged. This would also form part of 765 kV transmission corridor connecting Ranchi to Gaya. These lines can be used to evacuate power to the Eastern Region ISTS as well as to Jharkhand State. In view of above, provision of four nos. of 765 kV outgoing Line bays has been kept in the new 765 kV generation switchyard. The issue of power evacuation of the proposed project shall be taken up with appropriate Transmission Utility (STU or CTU) as per regulatory provision, based on allocation of power.		
12.00.00	METEOROLOGICAL DATA		
	The meteorological data from nearest observatory is placed at Annexure-II .		
13.00.00	PLANT WATER SCHEME		
	The Plant water scheme is described below.		
13.01.00	Equipment Cooling Water (ECW) System (Unit Auxiliaries)		
	The plant auxiliaries of Steam Generator and Turbine Generator shall be cooled by Demineralized (DM) water in a closed circuit. The primary circuit DM water shall be cooled through plate type heat exchangers by Circulating Water tapped from ACW system in a secondary circuit. The station auxiliaries such as Air compressors, Compressors of ash handling plant, compressor of mill reject system etc. shall also be cooled by Demineralized (DM) water in a closed 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.		
13.02.00	Not used		
13.03.00	Other Miscellaneous Water Systems		
	(a) The drinking water requirement of the plant shall be provided from water treatment plant. (b) Steam Cycle make-up water, makeup to the primary circuit of ECW (unit auxiliaries) system, boiler fill water shall be provided from demineralizing plant. (c) The quality of Raw Water & DM Water is enclosed with this sub-section as Annexure-III. (d) Effluent from various areas in TG & SG system shall be collected in respective pits in their areas and pumped to a common terminal point as shown in plant water scheme.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800 MW)		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO CS-9585-001-02	SUB-SECTION-IB PROJECT INFORMATION
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14.00.00	CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT All power plant structures and equipment, including plant auxiliary structures and equipment shall be designed for seismic forces as given in Part-B of this section.
15.00.00	CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT 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 Part-B of this section.

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SECTION – I
SPECIFIC TECHNICAL REQUIREMENTS
SUB-SECTION IA - Specific Technical Requirements (Mech.)
SUB-SECTION IB - Specific Technical Requirements (Electrical)
SUB-SECTION IC - Specific Technical Requirements (C & I)



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SUB-SECTION – IA

SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)



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1.0 INTENT OF SPECIFICATION

- 1.1 The intent of specification is to cover design (i.e. Preparation and submission of drawing/ documents including " As Built " drawings and O&M Manuals) , engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles (as applicable), fill of lubricants & consumables , mandatory spares along with spares for erection ,startup and commissioning as required, forwarding, proper packing, shipment and delivery at site, unloading, handling, transportation & storage at site, in site transportation, assembly, minor civil works, erection & commissioning, trial run at site and carrying out performance guarantee /Functional / Demonstration tests at site , obtaining CCOE approval & final handing over to end customer in flawless condition for project and package specified above complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.
- 1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor of the responsibility of providing such facilities to complete the supply, erection and commissioning, performance and guarantee of **HYDROGEN GENERATION PLANT**.
- 1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to highest standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.
- 1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing. Similarly, the extent of supply also includes all terms required for completion of the system and not withstanding that they may have been omitted in drawings / specifications or schedules.
- 1.5 The general term and conditions, instructions to tenderers and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.
- 1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under section-III of the specification. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser / Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.



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- 1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.
- 1.8 Deviations, if any, should be very clearly brought out clause by clause along with cost of withdrawal in the enclosed schedule (in section – III); otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/its customer.
- 1.9 In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, Section – IA shall prevail over section – IIA and Section-IB & IC shall prevail over Section-IIB & IIC , however more stringent requirement as per the interpretation of the owner shall apply.
- 1.10 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- 1.11 For definition of word like Contractor, bidder, supplier, vendor, Customer/ Purchaser / Employer, consultant, please referred relevant clause(s) of GCC.
- 1.12 “Note 1: - Bidder to note that the building along with foundation of equipment has already constructed at site. Bidder to accommodate their equipment within the foundation already constructed. Any modification required in foundation to accommodate bidder's equipment shall be part of bidder's scope. Bidder is advised to visit site for clarity of actual site condition w.r.t Hydrogen generation plant civil works before bid submission. Further equipment layout with foundation details of Hydrogen Generation Plant (BHEL Dwg. No. PE-V0-434-168-A017) is enclosed here with this specification & bidder to follow the same”.
- 1.13 “Note 2: - Bidder to note that MCC for Hydrogen Generation Plant has already manufactured and dispatched to site. Further, Bidder to note that the Final Electrical Load of all the drives are mentioned in sub-section IB and the same shall be adhered by the Bidder. In case if any modification required in MCC due to change of Load data the same shall be in bidder's scope.
- 1.14 “Note 3: - Bidder to note that Hydrogen Generation Skids (2nos.) has already manufactured and dispatched to site. Further, Bidder to note that the same shall be free issued to successful bidder. In case any modification is required in Hydrogen Generation Skids due to manufacturer's design, the same shall be in bidder's scope. Bidder is advised to visit site for clarity of actual site condition w.r.t Hydrogen generation plant skids before bid submission for skids details, BHEL Dwg. No. PE-V0-434-168-A002 is enclosed here with this specification & bidder to follow the same”. Further, refurbishment / replacement of already supplied item shall also be in bidder's scope.
- 1.15 Note-5 Following item already dispatched at site: -
 - a. Electrolyser
 - b. Lye Filter
 - c. Lye Pump
 - d. O2 Seperator
 - e. H2 Seperator
 - f. O2 Moisture Gas Seperator
 - g. H2 Moisture Gas Seperator
 - h. O₂ Gas Cooler
 - i. H₂ Gas Cooler
 - j. Feed DM Water Tank cum Lye Tank 200 L



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- k. Lye Circulation Pump
- l. DM Feed Water cum Lye Pump
- m. Catalyst Column
- n. Dryers
- o. Buffer Tank
- p. Hydrogen Gas Compressors with Motor.
- q. Rectifier Panel with Transformer
- r. Flow Indicator
- s. Pressure Indicator
- t. Pressure Transmitter
- u. Pressure Switch
- v. H₂ Moisture Sensor
- w. Trace O₂ (PPM) Sensor
- x. Pressure Transmitter
- y. Temperature Indicator
- z. Temperature Transmitter
- aa. Level Gauge
- bb. Level Transmitter DP Type
- cc. Dew Point Transmitter

2.0 SCOPE OF SUPPLY:

A) Scope of Supply by Bidder:-

- ~~2.1 Two streams of electrolyzers working in parallel (each of capacity minimum 6 Nm³/hr.).~~
- ~~2.2 Three (3) numbers of hydrogen gas compressors and drives (each of minimum 7.5 Nm³/hr.). Each compressor set shall be capable of compressing hydrogen gas from suction pressure corresponding to that of the low pressure at generation point to the pressure required to fill the hydrogen cylinders i.e. 150 Kg/cm² (gauge), with pressure gauge, safety relief valve, temperature gauge etc. along with flame proof electric motor, cell purging system, hydrogen gas buffer tanks.~~
- ~~2.3 One (1) no. Gas Washing Tank per stream or any other alternative device to remove traces of caustic potash entrained with hydrogen gas along with manometers at inlet and outlet, temperature gauge, level switches for controlling the level of DM water in the tank, etc.~~
- 2.4 One (1) off-line specific gravity measuring instrument for electrolyte.
- 2.5 One (1) no. on line thermal conductivity analyser.
- 2.6 Two (2) nos. Hydrogen filling stations with manifold isolating valve, safety valve etc. for both evacuation and simultaneous filling of minimum 4 cylinders (total 8 nos.) shall be provided with hydrogen at a maximum filling pressure of 150 Kg/cm² (gauge). Each filling manifold shall be provided with a common vacuum pump for evacuation of air from hydrogen cylinder prior to filling.
- 2.7 Two (2) nos. Nitrogen manifold common for both streams shall be provided. Each nitrogen manifold shall comprise of two 2 nos. for complete purging of the hydrogen gas streams, along with complete scavenging system comprising necessary piping network, all fittings, pressure reducing station etc.
- 2.8 One number tank of Capacity adequate for 5 days' normal requirement of hydrogen gas generation on continuous basis at rated capacity of total hydrogen generation plant shall be provided. Further, the tank is to be sized considering 12 hours operation per day. DM water tank



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- shall be fitted with removable drain connections, level transmitters, level indicators, conductivity meter etc.
- 2.9 Bidder to note that DM water shall be used in closed circuit with chiller unit for cooling of equipment. Chiller unit consist of two nos. Air cooled chillers, one number Chiller water storage tank of adequate capacity, two nos. chilled water re circulation pumps complete with drive motors along with strainers and all other necessary instruments, isolation valves, piping, flanges, pipe fittings etc.
- 2.10 ~~De-oxy units, coolers, hydrogen gas purification system, filling manifold, piping fitting, valves, complete with required instrumentation and other items as per P&ID for the hydrogen generation plant enclosed with this technical specification.~~
- 2.11 Bidder shall include vacuum pump and high-pressure cylinder testing apparatus along with all accessories for testing cylinders.
- 2.12 Bidder to include the Ventilation Requirement for hazardous and non-hazardous area including toilets and MCC in his scope for the H₂ Plant building as per the requirement specified in the technical specification. (Ventilation Fan 7000 cmh for Rectifier & MCC Panel Room, Ventilation Fan 11000 cmh for Hydrogen Generation Compressor Room, Ventilation Fan 3000 cmh for Chiller Room, Ventilation Fan 1100 cmh for Battery Room, Ventilation Fan 1200 cmh for Toilets)
- 2.13 Bidder shall also include in his scope Air-conditioners for his control panels etc. Bidder to specify the same in his offer.
- 2.14 PLC Software & Hardware with all Cards (AI, DI, DO etc), Complete Wired Panel, Control Desk Personal Computer & UPS, Printer etc. along with other accessories is in bidders' scope. (Refer PLC specification enclosed).
- 2.15 2X100% battery charger along with required nos. of battery and accessories is in bidders' scope. (Refer battery charger specification enclosed).
- 2.16 Necessary leak detectors along with sensors shall be also be in bidder's scope.
- 2.17 Eight (8) nos. cylinders shall be provided with hydrogen at a maximum filling pressure of 150 Kg/cm² (gauge) and Four (4) nos. nitrogen cylinders along with all accessories shall be in bidder's scope.
- 2.18 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.
- 2.19 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.
- 2.20 Bidder shall also provide connection, isolation device, manifold, piping etc. for N₂ gas connection to cell system for purging.
- 2.21 Bidder to note that N₂ gas required for purging the system during commissioning/Demonstration test/trial operation etc. till handing over the plant to shall be arranged by bidder.
- 2.22 Bidder shall include in his scope one lot of mandatory spares as per list enclosed as Annexure-VI of technical specification.
- 2.23 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.
- 2.24 Bidder shall guarantee that the equipment offered shall meet the rating and performance requirements for successful running of hydrogen Generation plant.
- 2.25 Start-up & Commissioning spares.
- 2.26 Counter flanges, blank flanges, isolation valves at all the terminal points as required as per system requirements.
- 2.27 All special tools necessary for proper maintenance or adjustment of the equipment packed in permanent box.
- 2.28 All necessary structural steel for pipe supporting structure, platforms, walkways / pathways and access stairs, mechanical plant and equipment, mechanical services and pipe work associated with Hydrogen Generation Plant.
- 2.29 Permanent ladder (not rungs) for approaching the top of tanks, valves for All steel inserts with lugs, plates, bolts, nuts, sleeves, edge angles and all other embedding components etc. as required to grout in civil works and to support/hold the equipment being supplied under this specification for opening/maintenance purpose.
- 2.30 All auxiliary steel structures (U-clamps, nuts, bolts, channels etc.) for fixing the pipe on the pedestal or trestles.



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- 2.31 Wrapping, coating and protection of all the buried pipe shall be as per IS 10221 or AWWA C 203.
- 2.32 Finish paint for touch-up painting of equipment after erection at site in sealed containers.
- 2.33 Set of special tools and tackles if required for maintenance and erection of equipment supplied.
- 2.34 All insert plates, puddle pipes, nuts and bolts, counter flanges, grouting material wherever applicable shall be in the scope of bidder.
- 2.35 Embedment plates with lugs shall also be provided by bidder as per system requirement.
- 2.36 Monitoring gadgets, instruments and equipment required for commissioning & maintenance (till PG test and plant handover).
- 2.37 Instrument hook up material shall be in bidder's scope.

3.0 SCOPE OF SERVICE:

The bidder's scope also includes the following services:

- i) Design and engineering of entire hydrogen generation Plant
- ii) Erection and commissioning, unloading, storage and handling at site.
- iii) Arrangement of all instruments and lab facilities to carry out trial run, commissioning and PG test.
- iv) Minor Civil work including chipping of foundation, grouting below base plate for all structures, equipment, grouting of anchor bolts wherever these are not placed in the foundation during casting of foundation itself etc. To the extent possible, vendor shall ensure to supply all foundation bolts timely so as to facilitate placement of these bolts while casting the foundation. Wrapping, coating and protection of all the buried pipe shall be as per IS 10221.
- v) In site transportation.
- vi) Pre- Commissioning work such as flushing, hydraulic testing etc. Necessary consumables and instrumentation as required for inspection and testing at works as well as at site including pre-commissioning activities shall be arranged by the successful bidder at their own cost.
- vii) Monitoring gadgets, instruments and equipment required for maintenance (till PG test and plant handed over).
- viii) All personal required during commissioning and PG test.
- ix) Complete grouting for equipment including grouting material, fixing and any concreting inside the plant.
- x) Trial run for requisite period.
- xi) Performance testing.
- xii) Painting as per enclosed painting schedule. However, any variation in the painting schedule as finally approved by customer shall be taken care by the bidder without any commercial and delivery implication. Colour coding scheme shall be intimated to vendor during detailed engineering.
- xiii) Final touch up painting at site.
- xiv) Obtaining CCE approval.
- xv) Preparation of civil assignment drawings i.e. pedestals details; insert plates / embedment's plates required for supporting pipes and equipment etc. and review of civil drawing prepared by BHEL based on civil assignment drawing of bidder. In case any modification is required in the civil work already done based on civil inputs given by vendor, rework shall be done at the cost and risk of the vendor.

4.0 TERMINAL POINTS:

TP1: - DM water shall be used as cooling water and shall be terminated at a distance of 10m from the hydrogen plant building at ambient temperature and pressure of 1 kg/cm² (min) and the same may be used as cooling water. Bidder to include in his scope all the equipment and accessories required for closed loop cooling with chiller unit for cooling of equipment. Chiller unit consist of two nos. Air cooled chillers, one number Chiller water storage tank of adequate capacity, two nos. chilled water re circulation pumps complete with drive motors along with strainers and all other necessary instruments, isolation valves, piping, flanges, pipe fittings etc.



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TP2, Feed water (Refer annexure – VIII, section-IA, 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 bidder's scope.

TP3: - Bidder to note that both Instrument and service air shall not be provided for hydrogen generation. Bidder to include in his scope all the equipment and accessories required for both instrument and service Air. Further distribution of Instrument and service air shall be in bidder's scope.

TP4, Drains: - All drains shall be terminated at one point by bidder.

5.0 SCOPE OF SUPPLY (ELECTRICAL)

Complete electrical as per specification / details indicated in Section IB (Specific Technical Requirement Electrical) and IIB (General Technical Requirement Electrical).

6.0 SCOPE OF SUPPLY (C&I)

Complete C&I as per specification / details indicated in Section IC (Specific Technical Requirement C&I) and IIC (General Technical Requirement C&I).

7.0 SCOPE OF SUPPLY (CIVIL)

- 7.1 Total Civil construction work at site is in BHEL's Scope of work, however complete grouting for equipment, pumps, blowers etc. fixing of equipment, pumps, blowers etc. as required shall be in bidder's scope.
- 7.2 Pedestals for pipe supports, however, auxiliary structure, supports components for piping is in bidder's scope.
- 7.3 Also detailed Civil Input drawing shall be provided by bidder. Successful bidder shall furnish civil assignment drawings. The corresponding CIVIL drawing prepared by BHEL / CIVIL agency, based on civil assignment drawing of bidder will be furnished to the successful bidder for concurrence

8.0 BIDDER TO FURNISH FOLLOWING DOCUMENT/INFORMATION ALONG WITH THE BID.

- 8.1 Pre-bid if any in enclosed pre-bid schedule.
- 8.2 Deviation schedule duly fill for deviation along with cost of withdrawal, if any.
- 8.3 Schedule of Declaration.
- ~~8.4 Guarantee Power Consumption in open as a part of tender specification.~~
- 8.5 Guaranteed Performance Data.

9.0 EXCLUSIONS

- a) DM, Service water and potable water up to the terminal point.
- b) All civil construction Works at site.

10.0 QP AND SUB VENDOR APPROVAL

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

11.0 SUB VENDOR

The sub vendor list (Annexure- II) enclosed is indicative only and is subject to approval / acceptance by customer. Bidder to propose his sub vendor list with back up documents (experience list, end



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user performance certificate as applicable) etc. The same shall subject to BHEL and Customer approval during detailed engineering stage without any commercial & delivery implication to BHEL.

12.0 DESIGN/CONSTRUCTION

- The P&IDs (Dwg.No.-PE-DG-434-168-A001) is enclosed herein in this section for bidder's compliance.
- The material of construction specified in specification are minimum requirements and material of construction for other components not specified shall be similarly selected by the bidder for intended duty which shall be subjects to customer approval during detailed engineering without any delivery and price implication to BHEL.
- The technical specification requirement for items which are not included shall be subject to customer/BHEL approval during detailed engineering stage. Vendor will submit all the backup documents for provenances of the technical details selected.

13.0 DRAWING/DOCUMENTS REQUIREMENT

For the Drawings/Documents submission schedule, please refer ANNEXURE-VII.

For the Drawings/Documents distribution Procedure, please refer ANNEXURE-IV. The bidder has to submit the revised drawing/document along with the compliance sheet indicating enumerate reply to all BHEL and customer comments or observations. Without compliance sheet the submission of the drawings/documents will not be considered and the delay on this account will be solely on bidder's side only. Bidder to comply with the observations of the BHEL and CUSTOMER without price & delivery implication.

14.0 SPARES

All the spares for the equipment under the contract provided by the vendor will strictly conform to the specifications and documents and will be identical to the corresponding main equipment/components supplied under the contract.

A) MANDATORY SPARES

- a. The list of mandatory spares which is to be considered by bidder in their scope are indicated in Annexure VI.
- b. All mandatory spares shall be delivered at site at least two months before scheduled date of initial operation of the first unit. However, spares shall not be dispatched before dispatch of corresponding main equipment.
- c. Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until and unless specified otherwise.
- d. Inspection of mandatory spares shall be in line with the approved quality plans for the respective items/equipment. The inspection categorization of mandatory spares shall also be in line with the approved Categorization plan for the respective items/equipment.

B) START-UP & COMMISSIONING SPARES

Start-up and commissioning spares are those spares which are required during the start-up and commissioning of the equipment/system. All spares used till the plant is handed over to the BHEL/Customer shall come under this category. The Bidder shall provide for an adequate stock of such start up and commissioning spares to be brought by him to the site for the plant erection and commissioning. They must be available at site before the equipment are energized. The unused spares, if any, should be removed from there only after the issue of Taking Over certificate. All start up spares which remain unused at the time shall remain the property of the Bidder.

Notes: -



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- a. The Bidder shall indicate the service expectancy period for the spares under normal operating conditions before replacement is necessary.
- b. All spares supplied under this contract shall be strictly inter changeable with the parts for which they are intended for replacements. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site e.g. small items shall be packed in sealed transparent plastic with desecrator packs as necessary.
- c. All the spares (mandatory) shall be manufactured along with the main equipment components as a continuous operation as per same specification and quality plan.
- d. Each spares part shall be clearly marked or labelled on the outside of the packing with its description. When more than one spares part is packed in a single case, a general description of the content shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purposes of identification.
- e. All cases, containers or other packages are to be opened for such examination as may be considered necessary by BHEL / Customer.
- f. The Bidder will provide the BHEL/Customer with all the addresses and particulars of his sub suppliers while placing the order on vendors for items/components/equipment covered under the contract and will further ensure with his vendors that the BHEL/Customer, if so desires, will have the right to place order for spares directly on them on mutually agreed terms based on offers of such vendors.
- g. The Bidder shall warrant that all spares supplied will be new and in accordance with the contract Documents and will be free from defects in design, material and workmanship.
- h. The bidder to provide datasheets/assembly drawings of the manufacturer/ any other relevant document showing Bill of Material(s), Make, Model Number, Part Number etc. through which the mandatory spares to be supplied can be uniquely identified.

15.0 ADDITIONAL REQUIREMENT

- Bidder to submit BBU during detailed engineering after approval of Basic documents. BBU shall be equal to BOQ for the package and there shall be no price and delivery implication is applicable to BHEL / customer for the same. None of the items supplied for the project as non-billable. Final Electrical Load list will be submitted by the successful bidder as per agreed drawing/ doc submission schedule. Thereafter any change in the electrical load list shall be entertained only subject to its feasibility, and BHEL reserves the right to debit the vendor cost of any changes necessitated in the switch gear /MCC on account of changed loads. Incomplete BBU shall not be review by BHEL.
- Any statutory requirement / clearance required for the package from government / local body shall be in bidder's scope.
- The vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval shall be taken from BHEL. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.
- KKS numbering if required, as per BHEL/Customer requirement shall be provided by the Bidder during detailed engineering stage without any commercial/delivery implication to BHEL.
- 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



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- without any extra charge shall provide the same.
- Buried piping shall be protected as under (as per IS-10221).
 - Surface cleaning by wire brush, power tool cleaning etc.
 - Apply one coat of coaltar/primer/enamel.
 - Apply one layer of tape comprising of coaltar. Application of tape shall conform to AWWA C-203/IS 10221 (appendix-B) with Minimum thickness of tape as 4MM +10%
 - Final Electrical Load list will be submitted by the successful bidder as per agreed drawing/ doc submission schedule. Thereafter any change in the electrical load list shall be entertained only subject to its feasibility, and BHEL reserves the right to debit the vendor cost of any changes necessitated in the switch gear /MCC on account of changed loads.
 - In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.
 - Bidders shall make Site visit in order to familiarize themselves with existing condition of site before submitting the bid in order to make their offer complete. During detail engineering also, the successful bidder shall be responsible for the correctness of details w.r.t. existing facility at site. Customer approval on any drawing having details of existing facility shall not be cited by the successful bidder a valid reason for any shortcoming in the work by them. BHEL shall also not entertain any cost implication for any lack of input data with regard to site during detail engineering.
 - Preparation of drawings / document / P&ID's in 3D modelling software and providing soft copy of same to BHEL.
 - Wherever local instruments for measurement of Flow, Pressure, Level is indicated in the P&ID, Bidder to provide Diaphragm seal type instrument for Chemical (all type and concentration), corrosive, viscous fluids application.
 - All the vertical pumps shall be considered as self-lubricating type unless specifically mentioned.
 - All piping, valves, fittings to be selected by bidder of minimum PN 10 or 150# class rating.

16.0 INSTRUCTIONS TO BIDDER

- a) The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve them of the responsibility of providing such facilities to complete the supply, erection and commissioning of Complete Pretreatment Plant.
- b) It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgment is not in full accordance herewith.
- c) The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.
- d) The general terms and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification are subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.
- e) While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different



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sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Vol-III of the specification **within 10 days of receipt of tender documents**. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of BHEL/Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by BHEL/ Customer as and when brought to their notice either by the bidder or by BHEL/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

- f) The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.
- g) Deviations, if any, should be very clearly brought out clause by clause along with cost of withdrawal in the enclosed schedule (in Vol – III); otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/its customer.
- h) In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- i) Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder/vendor and Customer/Purchaser/Employer will mean BHEL and/or Customer.
- j) The equipment covered under this specification shall not be dispatched unless the same have been finally inspected, accepted and dispatch release issued by BHEL/Customer as per approved QAP.
- k) BHEL's/Customer's representative shall be given full access to the shop in which the equipment are being manufactured or tested and all test records shall be made available to him.
- l) Pre-bid meeting shall be held before bid submission. Bidder to ask all their queries in pre-bid meeting.



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ANNEXURES



TITLE :

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SECTION : I

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ANNEXURE-I: QUALITY PLAN

HYDROGEN GENERATION PLANT

HYDROGEN GENERATION PLANT-TESTS

Tests/Check Items / 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						
1. Fillet welds/nozzles welds and knuckle portion of dished ends and all butt welds. 2. 100% butt welds and 100% for Tee joints and dished ends welds. 3. One per heat /HT batch. Notes. 1. Quantum of checks shall be 100% unless otherwise specified. # - Capacity and discharge pressure of Hydrogen gas compressor at its rated duty points with its job (own) motor shall be demonstrated and proved at shop. Vibration and noise levels of Hydrogen gas compressors shall also be demonstrated at shop.													

CLAUSE NO.	QUALITY ASSURANCE								एनटीपीसी NTPC
MOTOR									
TESTS/CHECKS TEMS/COMPONENTS	Visual	Dimensional	Make/Type/Rating /General Physical Inspection	Mech/Chem. Properties	NDT /DP/MPI/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment
Plates for stator frame, end shield, spider etc.	Y	Y	Y	Y	Y				Y
Shaft	Y	Y	Y	Y	Y	Y			Y
Magnetic Material	Y	Y	Y	Y			Y		
Rotor Copper/Aluminium	Y	Y	Y	Y			Y		Y
Stator copper	Y	Y	Y	Y			Y		Y
SC Ring	Y	Y	Y	Y	Y		Y	Y	Y
Insulating Material	Y		Y	Y			Y		
Tubes, for Cooler	Y	Y	Y	Y	Y				Y
Sleeve Bearing	Y	Y	Y	Y	Y				Y
Stator/Rotor, Exciter Coils	Y	Y	Y				Y	Y	
Castings, stator frame, terminal box and bearing housing etc.	Y	Y	Y	Y	Y			Y	
Fabrication & machining of stator, rotor, terminal box	Y	Y			Y			Y	Y
Wound stator	Y	Y					Y	Y	
Wound Exciter	Y	Y					Y	Y	
Rotor complete	Y	Y					Y		
Exciter, Stator, Rotor, Terminal Box assembly	Y	Y					Y		
Accessories, RTD, BTD,CT, Space heater, antifriction bearing, gaskets etc.	Y	Y	Y						
Complete Motor	Y	Y	Y						
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 upto 50KW. 2. Additional routine tests for Flame proof motors shall be applicable as per relevant standard 3. Makes of major bought out items for HT motors will be subject to NTPC approval. Y1 = for HT Motor / Machines only.									
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)			TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.:CS-9585-001-2			SUB-SECTION-E-51 MOTORS		Page 1 of 2	

CLAUSE NO.	QUALITY ASSURANCE										एनटीपीसी NTPC
MOTOR											
TESTS/CHECKS ITEMS/ COMPONENTS	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	Routine & Acceptance tests as per IS-325/IS-4722 /IS- 9283/IS 2148/IEC60034/IEC 60079-I	vibration	Over speed	Tan delta, shaft voltage & polarization index test	Paint shade, thickness & adhesion	
Plates for stator frame, end shield, spider etc.											
Shaft											
Magnetic Material	Y		Y								
Rotor											
Copper/Aluminium											
Stator copper			Y								
SC Ring											
Insulating Material			Y								
Tubes for Cooler		Y									
Sleeve Bearing		Y									
Stator/Rotor, Exciter Coils											
Castings, stator frame, terminal box and bearing housing etc.											
Fabrication & machining of stator, rotor, terminal box											
Wound stator											
Wound Exciter											
Rotor complete				Y	Y						
Exciter, Stator, Rotor, Terminal Box assembly											
Accessories, RTD, BTD,CT, , Space heater, antifriction bearing, gaskets etc.											
Complete Motor						Y	Y	Y	Y1	Y	
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 upto 50KW. 2. Additional routine tests for Flame proof motors shall be applicable as per relevant standard 3. Makes of major bought out items for HT motors will be subject to NTPC approval. Y1 = for HT Motor / Machines only.											
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)				TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.:CS-9585-001-2				SUB-SECTION-E-51 MOTORS		Page 2 of 2	

		QUALITY PLAN		CUSTOMER :		PROJECT		SPECIFICATION :				
				BIDDER/ :		TITLE		NUMBER :				
		SHEET 1 OF 2		VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01		SPECIFICATION TITLE				
		SYSTEM		ITEM AC ELECT. MOTORS BELOW 55KW (LV)		SECTION		VOLUME III				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	NOTE -1 & NOTE-3
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1		NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION : TITLE :			
	SHEET 2 OF 2		SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	
NOTES: 1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON 2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. 3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY												
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

INSTRUMENTATION CABLE													
ITEMS	TESTS												
	Conductor Resistance ® & (A)	High Voltage ® & (A)	Insulation Resistance ® & (A)	Constructional detail, dimensions (A)	Outer-Sheath/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) ++
1. Instrument cable twisted and shielded													
Conductor(IS-8130)	Y			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						
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. 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 item. Note : ® - Routine Test A - Acceptance Test Y - Test Applicable Note : Sampling Plan for Acceptance test shall be as per IS 8784 (As applicable) * 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) + Sample size will be One No. of each size/type per lot. ++ Sample size will be One No. sample for complete lot offered irrespective of size/type.													

CONTROL VALVE ACTUATORS AND ACCESSORIES.														
TESTS														
ITEMS	Make,model,tag (R)	Dimension®	Surface finish®	Heat Treatment®	Material Test Certificates®	IBR Certificates®	Hydraulic Test®	UT/Radiography for >900 lb rating®	MPI/DP®	Pressure Resistance®	Seat leakage®	Timing Open/Close®	Linearity/Hysterisis®	Functional Test, review for make and TC of accessories®
CONTROL VALVE AND ACTUATOR														
Overall	Y	Y	Y			Y	Y				Y	Y	Y	Y
Body		Y	Y	Y	Y			Y	Y	Y				
Bonnet		Y	Y	Y	Y									
Trim		Y			Y			Y*						
Pneumatic actuator	Y	Y								Y				
R- Routine Test														

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POWER SUPPLY FOR C&I SYSTEMS (UPS/BATTERY/BATTERY CHARGER/ACDB/DCDB)																		
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)	Premilinary light load test(R)	Load transfer retransfer test (R) *	AC input failiure and return test (R)	Parrallel 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
SMF BATTERY																		Y
ACDB/DCDB		Y	Y														Y	Y
BATTERY CHARGER		Y	Y	Y	Y	Y				Y					Y	Y	Y	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.																		

PROGRAMMABLE LOGIC CONTRLLER																
TESTS	ITEMS	Visual ®	GA, BOM ,Lay Out of components ®	Dimensions ®	Paint Shade/ Thickness/Adhesion ®	Alignment of Section ®	Component Rating/ Make / Type ®	Wiring ®	IR & HV ®	Review of TC for instruments/ Devices/ Recorders, Indicators/ Mosaic Items/ Transducers ®	Accessibility of TBS/ Devices ®	Illumination ®	Functional Check for Control Element , Annunciation ®	Mimic ®	Test as per IEC 1131 ® *	Test as per Std ® & (A)
		Y	Y	Y	Y		Y	Y	Y	Y	Y	Y			Y	Y
	1. PLC Panel	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y			Y	Y
	2. Control Desk With PLC	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		
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 test/ checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and Procedure alongwith relevant supporting documents. *Applicable for PLC Y - Test Applicable , ® - Routine Test (A) - Acceptance Test																

Process Connection & Piping														
ITEMS	TESTS													
	Visual ®	GA, BOM, Layout of component & construction feature®	Dimension ®	Paint Shade/thickness ®	Flattening,flaring,hydrottest,hardnes s 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)
ITEMS	Tests as per standards & specification													
	Visual ®	GA, BOM, Layout of component & construction feature®	Dimension ®	Paint Shade/thickness ®	Flattening,flaring,hydrottest,hardnes s 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)
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					
Gauge Board	Y	Y	Y	Y		Y		Y		Y			Y	
Impulse pipes and tubes	Y		Y		Y			Y						
Socket weld fittings ANSI B-16.11	Y		Y					Y						Y
Compression fittings	Y		Y					Y					Y	
Instrument valves & Valve manifolds	Y		Y					Y					Y	
Copper tubings ASTM B75	Y							Y						Y

Y – Test applicable

A- Acceptance Test

Note: R-Routine Test

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.

CONTROL DESK, LVS PANEL, PLC PANEL, SMOKE DETECTOR, FIRE ALARM & CONTROL SYSTEM

ITEMS	TESTS														
	Visual ®	GA, BOM ,Lay Out of components ®	Dimensions ®	Paint Shade/Thickness/Adhesion ®	Alignment of Section ®	Component Rating/ Make / Type ®	Wiring ®	IR & HV ®	Review of TC for instruments/ Devices/ Recorders, Indicators/ osaic Items/ Transducers ®	Accessibility of TBS/ Devices ®	Illumination ®	Functional Check for Control Element ,	Mimic ®	Test as per IEC 1131 ® *	Test as per Std ® & (A)
1. Control Desk	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		
2. LVS Panel	Y	Y	Y	Y	Y	Y	Y	Y	Y						Y
3. Annunciation, Control, PLC Panel	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y			Y	Y
4.Smoke Detectors (UL-268,EN-54 PT-7), Heat Detectors(UL-521/EN 54 PT-5) Annunciation/ Control Panel (UL -864, EN-54, PT-2)															Y
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 test/ checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and Procedure alongwith relevant supporting documents. • *Applicable for PLC • Y - Test Applicable , ® - Routine Test (A) - Acceptance Test															

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										SHEET 1 OF 8			
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		
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, Hardware, Hinges, Louvers & Filters, Fans & Panel Lamps	MA Visua	I	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 charger, Transformer, UPS.	Physical Inspection Physical Damages Dimensions Mounting Accessories	MA Visua	I	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 Visua	I	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 - Identification Labels - Physical Damages - Quantity - Spare Capacity	MA Visua	I	100%	Product Catalogue, Data sheets, Approved Configuration diagram, BOQ	As per ref documents. Test Certificates	BHEL Quality Inspection Report.	3/2	2	1		

LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics		\$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.		1 - BHEL 2 - Vendor 3 - Sub-vendor	

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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 \$			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				

LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics	\$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.	1 - BHEL 2 - Vendor 3 - Sub-vendor

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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 \$			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% F	AT Procedure	Test certification as per FAT	BHEL Quality Inspection Report.	2 2		1	

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

\$

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 W - Agency Witnessing the Test.
 V - Agency Verifying the Test.

1 - BHEL
 2 - Vendor
 3 - Sub-vendor

 PEM :: C&I	STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER											
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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 \$			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/Desktop 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

LEGEND: * CR - Critical characteristics
 MA - Major characteristics
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 W - Agency Witnessing the Test.
 V - Agency Verifying the Test.

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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.

	CHECK LIST FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER (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
				M	C	B	
1.0	CHECKS FOR VISULA, MODEL TAG NO.	SEE NOTE-1 BELOW	APPROVED TECHINCAL REQUIREMENT/ DATA SHEET	P	W	V	MFR TO CARRY OUT ROUTINE TEST ON 100%. WHEN MATERIAL CORELATION ARE NOT AVAILABLE MFR'S COMPLIANCE TO BE PROVIDED
2.0	PROCESS CONNECTION	-do-		P	W	V	
3.0	ACCURACY	-do-		P	W	V	
4.0	REPEATEABILITY	-do-		P	W	V	
5.0	HYSTERISIS	-do-		P	W	V	
6.0	EFFECT OF TEMP VARIATION ON ACCURACY	-do-		P	W	V	
7.0	SPAN /ZERO ADJUSTMENT	ONE/TYPE		P	W	V	
8.0	EFFECT OF SUPPLY VOLTAGE VARIATION	ONE/TYPE		P	W	V	
9.0	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
10.0	BURN IN TEST	ONE/TYPE		P	W	V	
11.0	DEGREE OF PROTECTION	ONE/TYPE		P	W	V	

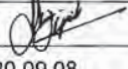
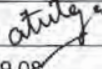
LEGEND:

M: MANUFACTURER/ SUB CONTRACTOR, C: CONTRACTOR/ NOMINATED INSP AGENCY, B: BHEL. P: PERFORM, W: WITNESS, V: VERIFICATION.

NOTE:

1. QUANTUM OF CHECK SHALL BE AS BELOW
100 % - BY MANUFACTURER
RANDOM FOR EACH TYPE - BY BHEL & CUSTOMER
2. MANUFACTURER TO MAINTAIN CALIBRATED INSTRUMENT HAVING BETTER ACCURACY THAN THE ITEM UNDER TEST. INSPECTING ENGINEER SHALL CHECK THE SAME.
3. IN CASE OF IMPORTED ITEMS CONTRACTORS SHALL REVIEW TC's AND NOT INSPECT.

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	SACHIN SRIVASTAVA	DILIP JEJURIKAR	ALKA TUTEJA
SIGNATURE			
DATE	30.09.08	30.09.08	30.09.08



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

SPECIFICATION NO.:

VOLUME

SECTION

REV. NO.

DATE:

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SL NO	TESTS/CHECKS	QUANTUM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS	AGENCY			REMARKS		
				P	W	V			
1.0	CHECK FOR		APPROVED TECHINICAL REQUIREMENT/ DATA SHEET/ RELEVANT STANDARD / MANUFACTURER CATALOGUE				MFR TO CARRY OUT ROUTINE TEST ON 100%.		
	1.1	MODEL NO/TAG NO		100%	M	C		C	
	1.2	RANGE/SCALE		100%	M	C		C	
	1.3	END CONNECTION		100%	M	C		C	
	1.4	SWITCH CONTACT RATING & NOS		100% M		C		C	
2.0	CALIBRATION						WHEN TC FOR MATERIAL FOR THE PROJECT NOT AVAILABLE , COMPLIANCE CERTIFICATE TO BE PROVIDED BY THE MANUFACTUR ER.		
	2.1	REPEATABILITY		100%	M	C		B	
	2.2	DIFFERENTIAL		100%	M	C		B	
	2.3	SET POINT ADJUSTMENT		100% M		C		B	
3.0	OVER PRESSURE & LEAK TEST	100% M			C	C			
4.0	REVIEW OF T.C. FOR MATERIAL OF--							--	B
	5.1	SENSOR		FOR LOT					
	5.2	MOVEMENT							
	5.3	HOUSING							
5.0	REVIEW OF T.C. FOR DEGREE OF PROTECTION	TYPE TEST	-	-	B				
6.0	REVIEW OF T.C. FOR MICRO SWITCH	FOR LOT	-	-	B				
7.0	ACCESSORIE S 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.



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

SPECIFICATION NO.:

VOLUME

SECTION

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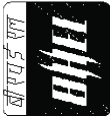
SL NO	TESTS/CHECKS	QUANTM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS	AGEN CY			REMARKS	
				P	W	V		
1.0	CHECK FOR		APPROVED TECHINCAL REQUIREMENT/ DATA SHEET				MFR TO CARRY OUT ROUTINE TEST ON 100%. WHEN MATL CORELATION ARE NOT AVAILABLE MFR'S COMPLIANCE TO BE PROVIDED	
	1.1 DIAL SIZE	100%		M	C	C		
	1.2 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. RELEIF 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	ACCESSORIE S AS APPLICABLE	100% M			C	C		

LEGEND:

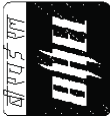
M: MANUFACTURER/ SUB CONTRACTOR, C: CONTRACTOR/ NOMINATED INSP AGENCY, B: BHEL. P: PERFORM, W: WITNESS, V: VERIFICATION.

NOTE:

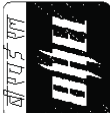
CONTRACTOR TO PROVIDE COMPLIANCE CERTIFICATE FOR TESTS/CHECKS VERIFIED BY CONTRACTOR AND SUBMIT THE SAME ALONGWITH TEST CERTIFICATES TO BE VERIFIED BY BHEL.

 PEM :: C&I		STANDARD QUALITY PLAN FOR SIGHT FLOW INDICATOR										QUALITY PLAN NO.: PE-QP-999-145-1029			
												VOLUME I IB			
												SECTION D			
												REV. NO. 00 DATE: 08.11.2000			
												Sl. No.	Component / operation	Characteristics Checked	* Category
P	W	V													
1.0	Material / Components														
1.1	Body, Cover, Interns, Flanges, Gaskets	1. Physical, Chemical Properties 2. Workmanship, finish and dimensions	MA Physical	Physical, Chemical Test	One Sample from each lot 100% MA	Approved drg. / data sheet / BHEL Spec.	Approved drg. / data sheet / BHEL Spec.	Test Certificate	3/2 ---		2,1#	# Compliance certificate to be verified.			
1.2	Window Glass	Strength, Transparency, dimensions	MA Visual	Visual, Measurement	one sample from each lot 100%	Manufacturing standards / drgs.	Manufacturing standards / drgs.	Inspection Report / Log Book	3/2 ---		2,1#				
2.0	Assembly	1. Marking – Tag No., Model, Range 2. Workmanship 3. Direction of flow stamping 4. Dimensions and end connections	MA Thermal shock, Visual, Measurement	Thermal shock, Visual, Measurement	one sample from each lot 100%	Approved drg. / data sheet / BHEL Spec.	Approved drg. / data sheet / BHEL Spec.	Test Certificate/ Inspection Report	3 ---		2,1#				
3.0	Routine Test	1. Operation, Calibration 2. Hydro Test	CR	Measurement	100%	- do -	No Leakage	- do -	2	1**	1	⊕ For flapper type			
									2	1**	1	**10% quantity with minimum of 1 piece / type & size			
									2	1	1				
									2	1	1				

LEGEND: * CR - Critical characteristics			\$			P - Agency Performing the Test.			1 - BHEL		
MA - Major characteristics			W			V - Agency Witnessing the Test.			2 - Vendor		
MI - Minor characteristics			V			- Agency Verifying the Test.			3 - Sub-vendor		

 STANDARD QUALITY PLAN FOR SIGHT FLOW INDICATOR		QUALITY PLAN NO.: PE-QP-999-145-1029 VOLUME I IB SECTION D REV. NO. 00 DATE: 08.11.2000 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	Painting	Shade & Finish	MA	Visual	100%	Approved drg. / data sheet / BHEL Spec.	Approved drg. / data sheet / BHEL Spec.	Inspection Report	2	1**	1	
5.0	Packing	Soundness MA		Visual	100%	- do -	- do -	- do -	2	---	---	

LEGEND: * CR - Critical characteristics
 MA - Major characteristics
 MI - Minor characteristics
 \$ P - Agency Performing the Test.
 W - Agency Witnessing the Test.
 V - Agency Verifying the Test.
 1 - BHEL
 2 - Vendor
 3 - Sub-vendor

 PEM :: C&I		STANDARD QUALITY PLAN FOR LEVEL GAUGES							QUALITY PLAN NO.: PE-QP-999-145-1028 VOLUME I IB SECTION D REV. NO. 00 DATE: 01.11.2000 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 / Components											
1.1	Body, Cover, Interns, Flanges, Gaskets	1. Physical, Chemical Properties 2. Workmanship, finish and dimensions	MA Physical	Physical, Chemical Test	One Sample from each lot 100% Material	Approved drg. / data sheet / BHEL Spec.	Approved drg. / data sheet / BHEL Spec.	Test Certificate	3/2 ---		2,1#	# Compliance certificate to be verified.
1.2	Glass Tube	Strength, Transparency, dimensions	MA Visual	Visual, Measurement	one sample from each lot 100%	Manufacturing standards / drgs.	Manufacturing standards / drgs.	Inspection Report / Log Book	3/2 ---		2,1#	
2.0	Assembly											
		1. Marking – Tag No., Model, Range 2. Workmanship 3. Scale graduation 4. Glass Opaque painting 5. Dimensions and end connections 1. Calibration	MA Thermal shock, Visual, Measurement	oughness & Thermal shock, Visual, Measurement	one sample from each lot 100%	Approved drg. / data sheet / BHEL Spec.	Approved drg. / data sheet / BHEL Spec.	Test Certificate/ Inspection Report	3 ---		2,1#	
			MA Visual	Visual	100%	- do -	- do -	Inspection Report	2	1	---	
			MA Visual	Visual	100%	- do -	- do -	- do -	2	1	---	
			MA Visual	Visual	100%	- do -	- do -	- do -	2	1	---	
			MA Visual	Visual	100%	- do -	- do -	- do -	2	1	---	For Reflex type
			MA Measurement	Measurement	100%	- do -	- do -	- do -	2	1	---	
			CR	Measurement	100%	- do -	- do -	- do -	2	1**	1	**10% quantity with minimum of 1 piece / type & size
3.0	Routine Test											
		2. Hydro Test	CR	Measurement	100%	- do -	No Leakage	- do -	2	1**	1	

LEGEND: * CR - Critical characteristics
 MA - Major characteristics
 MI - Minor characteristics
 \$ P - Agency Performing the Test.
 W - Agency Witnessing the Test.
 V - Agency Verifying the Test.
 1 - BHEL
 2 - Vendor
 3 - Sub-vendor

 PEM :: C&I		STANDARD QUALITY PLAN FOR LEVEL GAUGES										QUALITY PLAN NO.: PE-QP-999-145-1028 VOLUME I IB SECTION D REV. NO. 00 DATE: 01.11.2000 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				
4.0	Painting	Shade & Finish	MA Visual	Visual	100%	Approved drg. / data sheet / BHEL Spec.	Approved drg. / data sheet / BHEL Spec.	Inspection Report	2	1**	1					
5.0	Packing	Soundness MA		Visual	100%	- do -	- do -	- do -	2	---	---					

LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics		\$	P W V	- Agency Performing the Test. - Agency Witnessing the Test. - Agency Verifying the Test.	1 - BHEL 2 - Vendor 3 - Sub-vendor



PEM :: C&I

STANDARD QUALITY PLAN FOR FLOW ORIFICE PLATE ASSEMBLY

भारतीय वातावरण BHEL PEM :: C&I		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		1		OF	
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	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 IR - Inspection Reports DS – Data Sheet MA - Major characteristics TC - Test Certificates SP – Tech. Spec. MI - Minor characteristics AP – Approved Drawings/doc																	
\$ P - Agency Performing the Test. 1 - BHEL W - Agency Witnessing the Test. 2 - Vendor V - Agency Verifying the Test. 3 - Sub-vendor																	

 PEM :: C&I		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

STANDARD QUALITY PLAN FOR RESISTANCE TEMPERATURE DETECTOR WITH THERMOWELL										QUALITY PLAN NO.: PE-QP-999-145-1025			
										VOLUME IIB			
										SECTION D			
										REV. NO. 01		DATE: 21.03.2012	
										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	Raw Material / Component												
1.1	Resistance sheath	Material composition	CR	Chemical testing	One Sample from each lot	Approved drg. / data sheet	Relevant material std.	Test Certificate	3,2	---	2,1 ♣	♣ Relevant compliance certificate to be verified.	
1.2	Protective Sheath	Material composition	MA	Chemical testing		Approved drg. / data sheet	Relevant material std.	Test Certificate	3,2	---	2,1 ♣		
1.3	Terminal Head	Material composition	MA	Chemical testing		Approved drg. / data sheet	Relevant material std.	Test Certificate	3,2	---	2,1 ♣		
1.4	Thermowell⊕	1. Chemical properties	CR	Chemical composition	One Sample from each lot	Approved drg. / data sheet	Relevant material std.	Test Certificate	3,2	---	2,1		
		2. Dimensions (wall thickness concentricity of bore, OD & length)	MA	Measurement	100%	Approved drg., BHEL Spec.	Approved drg., BHEL Spec.	Inspection report	2	1♦	1	♦ BHEL to witness 25% Samples	
		3. Threading	MA	Thread matching	100%	Approved drg., BHEL Spec.	Approved drg., BHEL Spec.	Inspection Report	2	2,1♦	1		
		4. Leak Test (Hyd. test at 1.5 times design press)	CR	Visual	100%	Approved drg., BHEL Spec.	Approved drg., BHEL Spec.	Inspection Report	3,2	1**	2/1	⊕ IBR certificate wherever specified to be verified. **10% of total quantity with minimum of 2 random piece/type & size	

LEGEND:	* CR	- Critical characteristics	\$	P	- Agency Performing the Test.	1	- BHEL
	MA	- Major characteristics		W	- Agency Witnessing the Test.	2	- Vendor
	MI	- Minor characteristics;		V	- Agency Verifying the Test.	3	- Sub-vendor

PEM :: C&I

STANDARD QUALITY PLAN

FOR

RESISTANCE TEMPERATURE DETECTOR WITH THERMOWELL

QUALITY PLAN NO.: PE-QP-999-145-1025

VOLUME IIB

SECTION D

REV. NO. 01

DATE: 21.03.2012

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		
2.0	Final Inspection												
2.1	RTD Assembly	1. Workmanship 2. Marking 3. Dimensions	MA MA MA	Visual Visual Measurement	100% 100% 100%	Approved drg. / data sheet	Approved drg. / data sheet	Inspection Report	2 2 2	---- ---- ----	1* 1* 1*		
2.2	Routine Tests	1. Calibration (Resis Vs. Temp.) 2. Insulation Resistance 3. Thermal Response time	CR MA CR	Measurement Electrical Measurement	100% 100% One Sample from each type	IS:2848 IS:2848 IS:2848	IS:2848 IS:2848 IS:2848	Test Report Test Report Test Certificate	2 2 2	2 1 1	1 --- ---		
2.3	Type Test	Enclosure protection test	CR	Verification	Each type	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	3/2	----	1*		*Type Test Certificate (not more than 5 year old) to be verified Visual
3.0	Packing	Soundness of packing	MA	Visual	100%	Mfd std.	Mfd std.	Inspection Report	3/2	2	--		

LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics; Mfd std - Manufacturers' standard \$ 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 TEMPERATURE GAUGE AND THERMOWELL													QUALITY PLAN NO.: PE-QP-999-145-1027							
													VOLUME IIB							
													SECTION D							
													REV. NO. 01				DATE: 16-05-2007			
													SHEET 2				OF 4			
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									
1.4	Complete sensing element	1. Correct assembly and workmanship.	MA	Visual	100%	Mfr. Standard drawing	Mfr. Standard drawing	Log Book	2	---	---									
		2. Dimensions	MA	Measurement	100%	Mfr. Standard drawing	Mfr. Standard drawing	Log Book	2	---	---									
		3. Welding & other defects	MA	Visual	100%	Mfr. Standard	Mfr. Standard	Log Book	2	---	---									
1.5	Thermowell ⊕	1. Dimensions of wall thickness, concentricity of bore OD & Length.	MA	Measurement	100%	BHEL spec. / approved data sheet / Drg.	BHEL spec. / approved data sheet / Drg.	Log Book	2	1	1		BHEL to witness 10 % random samples.							
		2. Leak Test	CR	Hyd. test at 1.5 times of design pressure.	100%	BHEL spec. / approved data sheet / Drg.	BHEL spec. / approved data sheet / Drg.	Inspection report	3/2	2,1	1		⊕ IBR cert. wherever specified to be verified.							
		3. Threading	MA	Thread matching	100%	BHEL spec. / approved data sheet / Drg	BHEL spec. / approved data sheet / Drg	Inspection report	2	2,1	1		BHEL to witness 10% samples.							
2.0	Final Inspection																			
2.1	Assembly	1. Correct assembly, workmanship and finish	MA	Visual	100%	BHEL spec. / approved data sheet	BHEL spec. / approved data sheet	Inspection report	2	1	---									

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

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

1 - BHEL
 2 - Vendor
 3 - Sub-vendor

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. Mounting and connection	MA	Visual ad measurement	100%	-----do-----	-----do-----	Inspection report	2	1	---	
		3. Dial Scale	MA	Visual	100%	-----do-----	-----do-----	Log Book	2	1	---	
		1. Cleanliness	MA	Visual	100%	-----do-----	Free from scratches, dirt etc.	Log Book	2	---	2	
		5. Marking (S.No., Tag No.)	MA	Visual	100%	BHEL spec. / approved data sheet	BHEL spec. / approved data sheet	Log Book	2	1	---	
2.2	Routine Test	1. Accuracy	MA	Measurement	100%	BHEL spec. / Approved data Sheet.	BHEL spec. / Approved data Sheet.	Test Report	2	1	1	BHEL to witness 10% random Samples.
		2. Overload	CR	Measurement	10%	125% of FSD for range upto 400 Deg. C. 110% of FSD for range between 400 to 500 Deg. C. 100% of FSD for range above 500 Deg. C.	No Damage	Test Report	2	1	---	

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

\$ P W V
1 - BHEL
2 - Vendor
3 - Sub-vendor

प्री एच ई सी प्री एच ई सी PEM :: C&I		STANDARD QUALITY PLAN FOR TEMPERATURE GAUGE AND THERMOWELL										
		QUALITY PLAN NO.: PE-QP-999-145-1027										
		VOLUME IIB										
		SECTION D										
		REV. NO. 01 DATE: 16-05-2007										
SHEET 4 OF 4												
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$ P W V		Remarks	
		3. Response Time	MA	Measurement	10%	ASME PTC19.3	ASME PTC19.3	Test Report	2	1	1	BHEL to witness 10% random samples.
2.3	Type Test	1. Ambient temperature compensation 0-60 Deg. C	MA	Measurement	Sample	Bulb at constant temp. & case temp varied 0-60 Deg. C	No variation in measurement	Test Certificate	2	---	1	Existing test certificate (Not more than 5 year old) shall be furnished.
		2. Weather proofness	CR	Measurement	Sample	BHEL spec. / Approved data sheet.	BHEL spec. / Approved data sheet.	Test Certificate	3/2	---	1	---do---
3.0	Packing	Soundness of packing	MA	Visual	100%	BHEL Spec.	BHEL Spec.	Log Book	3/2	2	---	Refer Note-1

Note: 1. In the absence of BHEL specification for painting, vendor to obtain BHEL's approval on their painting specification / procedure.

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

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 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 \$ P W V	Remarks	

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 2. MT/PT	100% 100%	MSS-SP-55 ASME B 16.34	MSS-SP-55	Test Certificate	3/2	---	2,1		
						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										
\$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.										
PT - Dye penetrant Test MT- Magnetic Test										
RT- Radiographic Test UT - Ultrasonic Test										
1 - BHEL 2 - Vendor 3 - Sub-vendor										

 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		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 \$ P W V	Remarks

1.2	Diaphragm	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. 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	RT- Radiographic Test	PT – Dye penetrant Test	\$ P - Agency Performing the Test.				
MA		- Major characteristics	UT – Ultrasonic Test	MT- Magnetic Test	W - Agency Witnessing the Test.				
MI		- Minor characteristics			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-1006			
PEM :: C&I		Component / operation		Characteristics Checked		* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records		Agency \$		Remarks
Sl. No.											P	W	V		
1.4		Electrical items [Limit switches, Solenoids, Position Transmitter(if provided externally)]		1. Routine Test		MA	HV, IR, Continuity function	100%	Rele. Standards	Rele. Standards	Test Certificate	3	---	2,1	In case TC is not available, Actual test shall be conducted
				2. Degree of protection		MA	IP/NEMA Tests	One sample / type	Approved Data sheet	Approved Data sheet	Test Certificate	3	---	2,1	
1.5		Pressure Gauges		1. Performance		MA	Review of calibration certificates	100%	Mfr. Standard	Mfr. Standard	Test Certificate	3	---	2,1	
				2. Marking		MA	Visual	100%	Mfr. standard	Mfr. standard	Records	3	---	2,1	
2.0 I N PROCESS INSPECTION															
2.1		After machining, i, Body ii Bonnet iii Plug iv Valve Stem v seat ring/cage		1. Surface flaws		MA	Visual & MT/PT	100% (on accessible surfaces)	ASME B 16.34	ASME B 16.34	Test Records	2	---	1	Butt weld ends shall be included.
				2. Dimensional checks		MA	Measurement	100%	Mfr. Standard	Mfr. Standard	Records	2	---	1	
				3. Hard facing (wherever applicable)		MA	Hardness Measurement	One sample/Lot	Mfr. Standard	Mfr. Standard	Records	2	---	1	
2.2		Lapping		Machining surface contact		MA	Blue Matching	One sample/lot	-----	Proper Physical Contact	---	2	---	---	
3.0 TESTS ON COMPLETED VALVE															
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics															
\$ 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				Page 467 of 504
PEM :: C&I												VOLUME IIB				Page 467 of 504
												SECTION D				Page 467 of 504
												REV. NO. 06				Page 467 of 504
												DATE: 05.09.2013				Page 467 of 504
												SHEET 4 OF 7				Page 467 of 504
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 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:				\$				1 - BHEL			
* CR - Critical characteristics				P - Agency Performing the Test.				2 - Vendor			
MA - Major characteristics				W - Agency Witnessing the Test.				3 - Sub-vendor			
MI - Minor characteristics				V - Agency Verifying the Test.							

 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 5 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	

		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
		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	Refer Note-4
		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	

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

 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 SHEET 6 OF 7 DATE: 05.09.2013											
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks											
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 P	AINTING	Soundness of Painting	MA	Visual and Measurement	100%	BHEL specn. / Mfr. Standard	BHEL specn. / Mfr. Standard	Inspection Report	2	---	---	Refer Note-2											
7.0 P	ACKING	Soundness of Packing against transit damage	MA	Visual	100%	Mfr. Standard	Mfr. Standard	Inspection Report	2	---	---	Refer Note-3											
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics												\$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. 1 - BHEL 2 - Vendor 3 - Sub-vendor											

 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 7 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			

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	W - Agency Witnessing the Test.	2 - Vendor
	MI	- Minor characteristics			V - Agency Verifying the Test.	3 - Sub-vendor



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR TEMPERATURE SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **				Remarks
				M	C	B	D *	
1	TYPE, MODEL, SL. No., TAG No., RANGE	100%	APPROVED SPEC./ DATA SHEETS	P	W	V	R	
2	DIMENSIONS CHECK	100%	-do-	P	W	V	R	
3	ACCURACY	100%	-do-	P	W	V	R	
4	SWITCHING DIFFERENTIAL	100%	-do-	P	W	V	R	
5	CONTACT RATING / No. OF CONTACTS	RANDOM	-do-	P	W	V	R	
6	MATERIAL TC FOR BULB, CAPILLARY, ARMOUR	ONE / LOT	-do-	P	V	V	R	
7	HV / IR	RANDOM	-do-	P	W	V	R	
8	DEGREE OF PROTECTION	TYPE TEST	-do-	P	V	V	R	
9	THERMOWELLS							
9.1	DIMENSIONS, PROCESS CONN	100%	-do-	P	W	V	R	
9.2	MATERIAL TC	ONE / LOT	-do-	P	V	V	R	
9.3	HYD TEST	100%	-do-	P	W	V	R	
9.4	IBR CERTIFICATE, IF APPLICABLE		-do-	P	V	V	R	
10	REPEATABILITY	100%	-do-	P	V	V	R	
11	HYSTERESIS	100%	-do-	P	V	V	R	

Legend :

* Records identified with "R" shall be essentially included by Contractor in QA documentation.

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, D = Drawings / Documents, P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
25 % - By BHEL & Customer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- In case of imported items, contractor shall review TC's and not inspect.
- MFR to carry out routine test for 100%

CHECK LIST FOR ANNUNCIATORS

[illegible]

Legend :

* Records identified with "R" shall be essentially included by Contractor in QA documentation.

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, D = Drawings / Documents, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
100 % - By Manufacturer
50 % - By BHEL & Customer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.

CHECK LIST FOR BYPASS ROTAMETERS

[illegible]

Legend :

* Records identified with "R" shall be essentially included by Contractor in QA documentation.

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, D = Drawings / Documents, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
100 % - By Manufacturer
25 % - By BHEL & Customer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR TRANSMITTER

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **				Remarks
				M	C	B	D *	
1	CHECKS FOR VISUAL, MODEL, TAG No.	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	R	
2	PROCESS CONNECTION	-do-	-do-	P	W	V	R	
3	ACCURACY	-do-	-do-	P	W	V	R	
4	REPEATABILITY	-do-	-do-	P	W	V	R	
5	HYSTERESIS	-do-	-do-	P	W	V	R	
6	EFFECT OF TEMP VARIATION ON ACCURACY	-do-	-do-	P	W	V	R	
7	SPAN / ZERO ADJUSTMENT	ONE / TYPE	-do-	P	W	V	R	
8	EFFECT OF SUPPLY VOLTAGE VARIATION	ONE / TYPE	-do-	P	W	V	R	
9	EFFECT OF LOADING (500 OHM METERS)	ONE / TYPE	-do-	P	W	V	R	
10	HIGH PRESSURE TEST	SEE NOTE-1 BELOW	-do-	P	W	V	R	
11	BURN-IN TEST	ONE / TYPE	-do-	P	W	V	R	
12	DEGREE OF PROTECTION	ONE / TYPE	-do-	P	W	V	R	

Legend :

* Records identified with "R" shall be essentially included by Contractor in QA documentation.

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, D = Drawings / Documents, P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
Random for each type - By BHEL& Customer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- In case of imported items, contractor shall review TC's and not inspect.
- Manufacturer to carry out ROUTINE TEST on 100 %.



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR TEMPERATURE ELEMENT

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **				Remarks
				M	C	B	D *	
1	CHECKS FOR TYPE, MODEL No., TAG No., PROCESS CONN.	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	R	
2	STABILITY	-do-	-do-	P	W	V	R	
3	INSULATION RESISTANCE	-do-	-do-	P	W	V	R	
4	ENCLOSURE CLASS	-do-	-do-	P	W	V	R	
5	RESPONSE TIME	-do-	-do-	P	W	V	R	
7	ACCURACY	-do-	-do-	P	W	V	R	
8	HYDROSTATIC TEST	-do-	-do-	P	W	V	R	
9	ELECTRICAL CHARACTERISTIC OF SENSOR (CONTINUITY OF T/C WIRES & INSULATION RESISTANCE OF RTD LEADS w.r.t. BODY	-do-		P	W	V	R	
10	TEMP CURVES / CHARTS			P	V	V	R	
11	AMBIENT TEMP. EFFECT CHECK	-do-	-do-	P	W	V	R	
12	HV TEST	-do-	-do-	P	W	V	R	

Legend :

* Records identified with "R" shall be essentially included by Contractor in QA documentation.

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, D = Drawings / Documents, P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
Random - By BHEL & Customer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR ANALYTICAL INSTRUMENTS

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **				Remarks
				M	C	B	D *	
1	CHECK FOR VISUAL, MAKE, MODEL No., POWER SUPPLY	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V	R	
2	DIMENSIONS CHECK	-do-	-do-	P	V	V	R	
3	FUNCTIONAL CHECK	-do-	-do-	P	V	V	R	
4	LEAKAGE TEST	-do-	-do-	P	V	V	R	
5	HV / IR TEST	-do-	-do-	P	V	V	R	
6	LINEARITY	-do-	-do-	P	V	V	R	
7	RESPONSE TIME	-do-	-do-	P	V	V	R	
8	ENCLOSURE CLASS	-do-	-do-	P	V	V	R	TYPE TEST CERTIFICATE TO BE FURNISHED BY VENDOR
9	ACCESSORIES, AS APPLICABLE	-do-	-do-	P	V	V	R	
10	ACCURACY / CALIBRATION	-do-	-do-	P	V	V	R	
11	ALARM CONTACT TEST	-do-	-do-	P	V	V	R	
12	ANALOG OUTPUT CHECK	-do-	-do-	P	V	V	R	
13	BURN-IN TEST OF ELECTRONIC PARTS	1/LOT	-do-	P	V	V	R	
14	IN-BUILT INDICATOR, ZERO, SPAN, RANGE SCALE SELECTION ETC	SEE NOTE-1 BELOW	-do-	P	V	V	R	

Legend :

* Records identified with "R" shall be essentially included by Contractor in QA documentation.

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, D = Drawings / Documents, P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
100 % - By BHEL & Customer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- In case of imported items, contractor shall review TC's and not inspect.

CHECK LIST FOR SOLENOID VALVES

[illegible]

Legend :

* Records identified with "R" shall be essentially included by Contractor in QA documentation.

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL,
D = Drawings / Documents, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
100 % - By Manufacturer
25 % - By BHEL & Customer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.



TITLE :
3X800MW PATRATU TPP PHASE-1

SPECIFICATION NO. PE-TS-434-168-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR HYDROGEN
GENERATION PLANT**

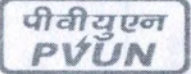
SUB-SECTION: IA

REV. NO. 00

DATE :

ANNEXURE II: SUB VENDORS

SUB VENDOR LIST FOR HGP

		PROJECT: 3 X800MW PVUNL PATRATU TPP PHASE - I (EPC)			 PATRATU VIDYUT UTPADAN NIGAM LIMITED					
AIROX NIGEN EQUIPMENTS PVT. LTD.		PACKAGE:HYDROGEN GENERATIONPLANT DOC NO.: 9585-001-110-QVM-Q-502 REV. NO.:01 DATE: 2506.2019 Page 1 of 2			 BHARAT HEAVY ELECTRICALS LIMITED					
Sr.No.	Item	QP/ Insp. Cat.	QPNNo.	QPSub. Schedule	QP Approval Schedule	Proposed sub- supplier	Place	Sub- supplier s approval status/ category	Sub- supplier Details submiss ion schedul	Remarks

1	Hydrogen Generation Skid a) Electrolyser b) Gas Separator c) Catalyst purifier & dryer d) Moisture & gas separator e) Coolers & condensers f) Filters g) DM cum lye tank h) Buffer tank	I				Airox Nigen Equipments Pvt. Ltd., India	Ahmedabad	A		
2	Manifold (for hydrogen and nitrogen)	III				Airox Nigen Equipments Pvt. Ltd., India	Ahmedabad	A		
3	Manifold valves	III				BHEL Approved Source				
4	Hydrogen cylinder rack	III				Airox Nigen Equipments Pvt. Ltd., India	Ahmedabad	A		
5	Vacuum Pump	III				BHEL Approved Source				

Amir

11/07/19

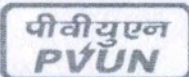
SUB VENDOR LIST FOR HGP

		PROJECT: 3 X800MW PVUNL PATRATU TPP PHASE - I (EPC)					PATRATU VIDYUT UTPADAN NIGAM LIMITED			
AIROX NIGEN EQUIPMENTS PVT. LTD.		PACKAGE:HYDROGEN GENERATIONPLANT					BHARAT HEAVY ELECTRICALS LIMITED			
		DOC NO.: 9585-001-110-QVM-Q-502								
		REV. NO.:01	DATE: 2506.2019	Page2of 2						
Sr.No.	Item	QP/ Insp. Cat.	QPNNo.	QPSub. Schedule	QP Approval Schedule	Proposed sub- supplier	Place	Sub- supplier s approval status/ category	Sub- supplier Details submiss ion schedul	Remarks
6	DM Water cum Lye Making Pump	III				BHEL Approved Source				
7	Hydrogen Gas Compressor (Diaphragm type)	II				Beijing Yitong Huizhi Compressor Manufacturer Co. Ltd.	China	A		
8	Lye circulation pump	III				BHEL Approved Source				
9	Chiller	III				Airox Nigen equipments pvt. Ltd.	Ahmedabad	A		
10	HDPE DM Water Storage Tank	III				BHEL Approved Source				
11	Hydrogen & Nitrogen Cylinders	III				BHEL Approved Source				

Amit

11/09/19

SUB VENDOR LIST FOR HGP

		PROJECT: 3 X800MW PVUNL PATRATU TPP PHASE - I (EPC)					PATRATU VIDYUT UTPADAN NIGAM LIMITED			
AIROX NIGEN EQUIPMENTS PVT. LTD.		PACKAGE:HYDROGEN GENERATIONPLANT					BHARAT HEAVY ELECTRICALS LIMITED			
		DOC NO.: 9585-001-110-QVM-Q-502								
		REV. NO.:01	DATE: 2506.2019	Page3of 4						
Sr.No.	Item	QP/ Insp. Cat.	QPNo.	QPSub. Schedule	QP Approval Schedule	Proposed sub- supplier	Place	Sub- supplier s approval status/ category	Sub- supplier Details submiss ion schedul	Remarks

12	Valves (Ball, Needle, Check, any other valve)	III				BHEL Approved Source				
13	Pipe, Structural steel, Nut bolts, Clamps & Fittings etc.	III				BHEL Approved Source				
14	AC	III				BHEL Approved Source				
15	Ventilation Fan	III				BHEL Approved Source				
16	Instrument air compressor	III				BHEL Approved Source				
17	Cylinder testing apparatus	III				Airox nigen equipments pvt ltd	Ahmedabad	A		

LEGENDS:-

Amit

11/07/19

SUB VENDOR LIST FOR HGP

		PROJECT: 3 X800MW PVUNL PATRATU TPP PHASE - I (EPC)					PATRATU VIDYUT UTPADAN NIGAM LIMITED				
AIROX NIGEN EQUIPMENTS PVT. LTD.		PACKAGE:HYDROGEN GENERATIONPLANT					BHARAT HEAVY ELECTRICALS LIMITED				
		DOC NO.: 9585-001-110-QVM-Q-502									
		REV. NO.:01	DATE: 2506.2019	Page4of 4							
Sr.No.	Item	QP/ Insp. Cat.	QPNo.	QPSub. Schedule	QP Approval Schedule	Proposed sub- supplier	Place	Sub- supplier s approval status/ category	Sub- supplier Details submiss ion schedul	Remarks	

1. QP/INSPNCATEGORY:

CAT-I: For these items the Quality Plans are approved by Owner and the final acceptance will be on physical inspection witness by Owner.

CAT-II: For these items the Quality Plans are approved by Owner, however no final inspection shall be done by owner. Final acceptance by Owner shall be on the basis of review of documentation as per approved QP.

CAT-III: For these items Quality control to be exercised as per Main Contractor Quality Assurance System. The final acceptance by NTPC shall be on the basis of Certificate of Conformance (COC) by Main Contractor.

2. SYSTEM SUPPLIER / SUB-SUPPLIER APPROVAL STATUS CATEGORY

A- For these proposed vendor is acceptable to NTPC / PVUNL. To be indicated with letter 'A' in the list along with the condition of approval, if any.

DR- For these items "Detailed Required" for NTPC / PVUNL review. To be indicated with letter 'DR' in the list.

Amit
11/7/19
(Amit Kr. Gang)
BHEL

Kamlesh Singh
11/07/19
PVUNL, Patratu

NTPC	Project : Patratu STPP 3X800 MW				Doc No	QA-C&I & Elect - HGP
	Package : Hydrogen Generation Plant		Sub-Vendor List		Rev No	1
	Main Contractor : BHEL - PEM		Electrical and Control & Instrumentation Items		Date	11.07.2019
	Sub Contractor : AIRON NIGEN					1 of 5
	Contract No. : 9585-001-155					
Sl No.	Item	QP/ Insp. Cat.	Acceptable Supplier As Per Database	Place of Manufacturing	Approval Status	Remarks
Control and Instrumentation Item list - Controlled Items						
1	Blank Panels / Cabinets / Control Desk	III	Rittal	Bangalore	A	
			Hoffman	Bangalore	A	
			Pyrotech	Udaipur	A	
			BHEL	Bangalore	A	
3	Coupling / Interposing Relays	III	Paramount /Omron/Oen/Jyoti/Elsta Or OEM Approved Sources			NOTE-6
4	Intellegent Battery Charger 24 DC/ DCDB / BHMS	II	Chabbi Electricals	Jalgaon	A	Rectifier module, Controller module and Battery Health monitoring system shall be of M/s VERTIV make
		II	Eltech	Gurgaon	A	Unit-II for assembly and function testing only
		II	MasTech	Jalgaon	A	Rectifier modules shall be of Setec, China
		II	VERTIV ENERGY PVT LTD	Mumbai	A	Rectifier module, Controller module and Battery Health monitoring system shall be of M/S VERTIV China
5	Battery (Ni-Cd)	II	AMCO SAFT INDIA LIMITED	Bengaluru	A	
		II	HBL POWER	Hyderabad	A	Upto 990AH(H type)
		II	HOPPECKE BATTERIEN GMBH & CO KG	Germany	A	
8	PLC System	I	GE Intellegent Plateforms Pvt Ltd	Bangalore	A	
			ABB	Bangalore	A	
			Schneider	Nasik	A	
			Rockwell	Sahibabad	A	
			Siemens	Nasik	A	
			Honeywell	Pune	A	1-PLC modules should be procured from M/s Honeywell Co Ltd, Korea. 2-Make of Panel (Blank Enclosure). Terminal block, Network components & interposing relay should be from NTPC approved source.

	Project : Patratu STPP 3X800 MW				Doc No	QA-C&I & Elect - HGP
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	Sub Contractor : AIRON NIGEN					2 of 5
	Contract No. : 9585-001-155					
Sl No.	Item	QP/ Insp. Cat.	Acceptable Supplier As Per Database	Place of Manufacturing	Approval Status	Remarks
11	Terminal Block (Cage And Clamp Type)	III	Weidmuller	Germany	A	
			Phoenix	Germany / India	A	
			Wago	Germany / India	A	
			Elmex	Vadodara	A	Model should have CE Marking
12	Transmitter (Electronic) (Pressure, DP, Flow, Level Application)	III	ABB Ltd	Bangalore	A	2600T & critical item from ABB Italy/ Their approved source
			Emerson Process Management Pvt Ltd	Pawane	A	
			Siemens Ltd	Thane	A	Model:-SITRANS P
			Honeywell Automation India Ltd	Pune	A	
			Baldota Control And Equipment Pvt Ltd	Navi Mumbai	A	PT & DPT of LD 301 Series (SMAR)
			Yokogawa India Limited	Bangalore	A	EJA-E 110,430,530 SERIES & all raw material and BOI under knocked down condotion (sensor assembly as a single unit) shall be sourced from M/S Yokogawa Japan
			M/S Endress + Hauser India Automation Instrument Pvt Ltd	Aurangabad	A	
			Fuji Electric	France	A	FCX - AIII Series
Following C&I items to be supplied as per main contractor approved sources meeting the NTPC Specification requirement						
1	Air Filter Regulator/ Lubricator	III	Main Contractor approved sources			
2	Annunciator	III	Main Contractor approved sources			
3	Battery Health Monitoring System	III	Main Contractor approved sources			
4	Compression Fittings(Ss)	III	Main Contractor approved sources			
5	Conduits / Pipe (Gi)	III	Main Contractor approved sources			
6	Conduits Lead Coated (Flexible)	III	Main Contractor approved sources			
7	Copper Tubing/ Brass Connectors	III	Main Contractor approved sources			
8	Dew Point Meter	III	Main Contractor approved sources			
9	Desk for Ows/ Ews/ Printer/ Server	III	Main Contractor approved sources			
10	Flow Gauge	III	Main Contractor approved sources			
11	Flow Switch	III	Main Contractor approved sources			
12	FRP Junction Box	III	Main Contractor approved sources			

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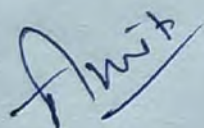
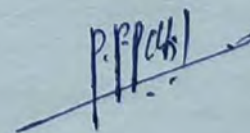
P. P. Patil

	Project : Patratu STPP 3X800 MW				Doc No	QA-C&I & Elect - HGP
	Package : Hydrogen Generation Plant		Sub-Vendor List		Rev No	1
	Main Contractor : BHEL - PEM		Electrical and Control & Instrumentation Items		Date	11.07.2019
	Sub Contractor : AIRON NIGEN					3 of 5
	Contract No. : 9585-001-155					
Sl No.	Item	QP/ Insp. Cat.	Acceptable Supplier As Per Database	Place of Manufacturing	Approval Status	Remarks
13	Furniture for Control Room(Chair, Almira, Lock)	III	Main Contractor approved sources			
14	Graphic Interface Unit	III	Main Contractor approved sources			
15	Hand Held Calibrator	III	Main Contractor approved sources			
16	Instrument Tube Fittings (Air)	III	Main Contractor approved sources			
17	Instrument Valve(Needle Valve)	III	Main Contractor approved sources			
18	Level Gauge (Transperent & Reflex, Tubular Type)	III	Main Contractor approved sources			
19	Level Switch - Float/Displacer Type	III	Main Contractor approved sources			
20	Limit Switch	III	Main Contractor approved sources			
21	Mini UPS Up to 3.5 Kva	III	Main Contractor approved sources			
22	Pr./ Vacuum/ Dp Gauges	III	Main Contractor approved sources			
23	Press, Dp, Vacuum Switch	III	Main Contractor approved sources			
24	Printer (Dot Matrix)	III	Main Contractor approved sources			
25	Printer (Inkjet / Laser)	III	Main Contractor approved sources			
26	Rotameter	III	Main Contractor approved sources			
27	Sight Flow Indicator	III	Main Contractor approved sources			
28	Solenoid Valve	III	Main Contractor approved sources			
29	Temperature Gauge(With Thermowell)	III	Main Contractor approved sources			
30	Temperature Switch	III	Main Contractor approved sources			
31	Valve Manifolds	III	Main Contractor approved sources			
32	Thermocouple, RTD and Thermowell	III	Main Contractor approved sources			
33	Cable (skid Mount)	III	Main Contractor approved sources			

Signature

Signature

	Project : Patratu STPP 3X800 MW				Doc No	QA-C&I & Elect - HGP
	Package : Hydrogen Generation Plant		Sub-Vendor List		Rev No	1
	Main Contractor : BHEL - PEM		Electrical and Control & Instrumentation Items		Date	11.07.2019
	Sub Contractor : AIRON NIGEN					4 of 5
	Contract No. : 9585-001-155					
Sl No.	Item	QP/ Insp. Cat.	Acceptable Supplier As Per Database	Place of Manufacturing	Approval Status	Remarks
Electrical Item List - Controlled items						
1	Rectifier Transformer Panel	I	Ruttonsha	Vadodara	A	
Following Electrical items to be supplied as per OEM/ Main contractor approved sources meeting the NTPC Specification requirement						
1	Compressor Motor	III	Crompton Greaves	Mumbai	A	OEM approved sources
		III	ABB	China	A	OEM approved sources
2	Vaccum Pump Motor	III	Crompton Greaves	Mumbai	A	OEM approved sources
3	Lye circulation Pump Motor	III	Crompton Greaves	Mumbai	A	OEM approved sources
		III	Hindustan	Kolkata	A	OEM approved sources
4	DM feed cum lye pump motor	III	Crompton Greaves	Mumbai	A	OEM approved sources
5	Cable Glands	III	Main contractor approved sources		A	Refer Note 1
6	Junction Box (Flame Proof and Non flame Proof type)	III	Main contractor approved sources		A	Refer Note 1
7	Cable Tray (Skid mount)	III	Main contractor approved sources		A	
8	Cable (Skid mount)	III	Main contractor approved sources		A	
LEGENDS :						
1.0 SYSTEM SUPPLIER/ SUB SUPPLIER APPROVAL STATUS CATEGORY						
A - For those items proposed vendor is acceptable to Customer. To be indicated with letter "A" in the list along with the condition of approval, if any.						
DR - For those items "Detailed Required" for Customer review. To be identified with letter "DR" in the list. For these items, vendor shall be proposed for owner acceptance within the agreed contract schedule of the package						
SQP-Standard Quality Plan RQP-Reference Quality Plan						

	Project : Patratu STPP 3X800 MW				Doc No	QA-C&I & Elect - HGP
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	Sub Contractor : AIRON NIGEN					5 of 5
	Contract No. : 9585-001-155					
Sl No.	Item	QP/ Insp. Cat.	Acceptable Supplier As Per Database	Place of Manufacturing	Approval Status	Remarks
2.0 QP INSPECTION CATEGORY :						
CAT - I : For those items the Quality Plans are approved by Customer and final acceptance will be on physical inspection witness by Customer						
CAT - II : For those items the Quality Plans are approved by Customer. However no physical inspection shall be done by Customer. The final acceptance by Customer shall be on the basis of review of documents.						
CAT - III : For those items Main supplier approves Quality Plans. The final acceptance by Customer shall be on the basis of Certificate of Conformance by main supplier.						
UNITS/WORKS : Place of manufacturing- Place of main supplier of multi units/works.						
* - Inspection category will be decided during vendor evaluation.						
NOTES: As applicable (if required)						
Note 1 : VDE / CE / UL / CSA Marking Certification preferably from Third Party Agency or BIS Approval Letter shall be submitted for NTPC's Verification /Information.						
Note 2 : Blank						
Note 3 : For the items not appearing in the preaward list and falls in the scope of supply of the bidder, bidder and Customer will mutually discussed in future.						
Note 4 : Empty cabinets, computers, signal isolator/ multiplier and TB shall also be acceptable from owner accepted in QP. If the total integrated panel and FAT is conducted indigenously.						
Note 5 : For the C & I instrumnts mounted on the skid of the main item or supplied as a integral part of the main item, instrument to be supplied as per proven practice of the manufacturer meeting the Customer technical specification requirement.						
Note 6 : This item is a bought out componenet of main equipments like DDCMIS, PLC, TSI, CCTV, PA system etc.						
Note 7 : For these controlled items, vendor shall be proposed for owner acceptance with-in the agreed contract schedule of the package.						
Note 8 : Mandatory Spares to be treated as NTPC inspection category CAT - III.						

Amit
 (Amit Kr. Gars)
 BHEL
 11/7/19

P.P. Patil
 11/07/2019
 PRASHANT P. PATIL
 AGM (QA & Engg)



TITLE :
3X800MW PATRATU TPP PHASE-1

SPECIFICATION NO. PE-TS-434-168-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR HYDROGEN
GENERATION PLANT**

SUB-SECTION: IA

REV. NO. 00

DATE :

Notes:-

1. The sub vendor list above is indicative only and is subject to BHEL and customer approval during detailed engineering stage without any commercial & delivery implication to BHEL.
2. The inspection category will be intimated after award of contract by BHEL/customer. However the same will be adhered by the bidder without any commercial and delivery implication to BHEL/customer.



TITLE :

3X800MW PATRATU TPP PHASE-1

SPECIFICATION NO. PE-TS-434-168-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR HYDROGEN
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REV. NO. 00

DATE :

ANNEXURE III: FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES



TITLE : 3X800MW PATRATU TPP PHASE-1	SPECIFICATION NO. PE-TS-434-168-A001	
	SECTION : I	
	TECHNICAL SPECIFICATION FOR HYDROGEN GENERATION PLANT	
	REV. NO. 00	DATE :

The Bidder shall guarantee that the equipment offered shall meet the rating and performance requirements stipulated for various equipment covered in this specifications.

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.

The bidder shall demonstrate all the guarantees covered herein during demonstration test / PG test.

The various tests which are to be carried out during demonstration tests are listed in the specification. The guarantee tests shall be conducted by the bidder at site in presence of BHEL/ CUSTOMER. All costs associated with the tests shall be included in the bid price.

In case during demonstration test /PG test, it is found that the equipment/system has failed to meet the guarantees, the bidder 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 BHEL/ CUSTOMER and re-conduct the demonstration test(s) / PG test with BHEL/ CUSTOMER's consent.

Hydrogen Generation Plant

- i. Capacity and discharge pressure of hydrogen gas compressors at its rated duty point shall be demonstrated and proved at site.
- ii. Electrolyser & rectifier capacity and power consumption shall be demonstrated at site.
- iii. Parallel operation of two streams shall be demonstrated at site. Purity level and moisture content of hydrogen shall be demonstrated at site.
- iv. Hydrogen generation plant capacity (stream wise) shall be demonstrated at site.
- v. Vibration level and noise level of hydrogen gas compressors shall be demonstrated at site.



TITLE :

3X800MW PATRATU TPP PHASE-1

SPECIFICATION NO. PE-TS-434-168-A001

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DATE :

ANNEXURE IV : DRAWING DOCUMENTS DISTRIBUTION PROCEDURE

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS (Annexure-VI)			एनटीपीसी NTPC																																																								
	<table><tr><th>S.No</th><th>Description of Drgs/Docs</th><th>No of Prints</th><th>No of CD ROMs/DVDs/Portable Hard Disk</th></tr><tr><td rowspan="8">1</td><td>Drawings, Data sheets, Design calculations, Purchase specifications and other documents</td><td></td><td></td></tr><tr><td>First submission and submission with major changes</td><td></td><td></td></tr><tr><td>▪ Layout (A0&A1 sizes)</td><td>4</td><td>-</td></tr><tr><td>▪ Other Drawings/Documents (A0&A1 sizes)</td><td>2</td><td>-</td></tr><tr><td>▪ P&ID (All sizes)</td><td>4</td><td>-</td></tr><tr><td>a) Final drawings/documents (Directly to site)</td><td>6</td><td>2</td></tr><tr><td>b) "As Built" Drawing/Documents (Directly to site)</td><td>6</td><td>2</td></tr><tr><td>c) Analysis reports of Equipments / piping /structures components/system employing software packages as detailed in the specifications.</td><td>2</td><td>2</td></tr><tr><td>2</td><td>Erection Manual (Directly to site)</td><td>4 sets</td><td>2</td></tr><tr><td rowspan="2">3</td><td>Operation & Maintenance manual</td><td rowspan="2">1 set</td><td rowspan="2">--</td></tr><tr><td>i) First Submission</td></tr><tr><td></td><td>ii) Final Submission (Directly to site)</td><td>4 sets</td><td>2</td></tr><tr><td rowspan="2">4</td><td>Plant Hand Book</td><td rowspan="2">1</td><td rowspan="2">1</td></tr><tr><td>i) First Submission</td></tr><tr><td rowspan="2">5</td><td>Commissioning and Performance Test Procedure manual</td><td rowspan="2">1 set</td><td rowspan="2">--</td></tr><tr><td>i) First Submission</td></tr><tr><td></td><td>ii) Final Submission (Directly to site)</td><td>4 sets</td><td>2</td></tr></table>				S.No	Description of Drgs/Docs	No of Prints	No of CD ROMs/DVDs/Portable Hard Disk	1	Drawings, Data sheets, Design calculations, Purchase specifications and other documents			First submission and submission with major changes			▪ Layout (A0&A1 sizes)	4	-	▪ Other Drawings/Documents (A0&A1 sizes)	2	-	▪ P&ID (All sizes)	4	-	a) Final drawings/documents (Directly to site)	6	2	b) "As Built" Drawing/Documents (Directly to site)	6	2	c) Analysis reports of Equipments / piping /structures components/system employing software packages as detailed in the specifications.	2	2	2	Erection Manual (Directly to site)	4 sets	2	3	Operation & Maintenance manual	1 set	--	i) First Submission		ii) Final Submission (Directly to site)	4 sets	2	4	Plant Hand Book	1	1	i) First Submission	5	Commissioning and Performance Test Procedure manual	1 set	--	i) First Submission		ii) Final Submission (Directly to site)	4 sets	2
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EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2	GENERAL TECHNICAL REQUIREMENTS Annexure-VI	PAGE 83 OF 111																																																								

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS (Annexure-VI)				
	S.No	Description of Drgs/Docs	No of Prints	No of CD ROMs/DVDs/Portable Hard Disk	
	6	Performance and Functional Guarantee Test Report i) First Submission	2 sets	--	
		ii) Approved Copies (Direct to Site)	4 sets	2	
	7	Project Completion Report (Directly to site)	6 sets	2	
	8	QA programme including Organisation for implementation and QA system manual(with revisions)	1	--	
	9	Vendor details in respect of proposed vendors including contractor's evaluation report.	2	--	
	10	Manufacturing QPs, Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc			
		i) For review/comment	1	--	
		ii) Approved final copies of Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc (Direct to Site)	4	2	
	11	Welding Manual, Heat Treatment Manuals, Storage & preservation manuals			
		i) For review/comment	1 set	--	
		ii) Approved copies (Direct to Site)	4 sets	2	
	12	QA Documentation Package for items / equipment manufactured and despatched to site	2 sets	2	
	13	QA Documentation Package for field activities on equipment/systems at site	2 sets	2	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-C BID DOC. NO.:CS-9585-001-2		GENERAL TECHNICAL REQUIREMENTS Annexure-VI	PAGE 84 OF 111



TITLE :

3X800MW PATRATU TPP PHASE-1

SPECIFICATION NO. PE-TS-434-168-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR HYDROGEN
GENERATION PLANT**

SUB-SECTION: IA

REV. NO. 00

DATE :

ANNEXURE V: PAINTING SPECIFICATION

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.00.00	SPECIFICATION OF SURFACE PREPARATION & PAINTING			
1.01.00	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.			
1.02.00	All paints shall be delivered to job site in manufacturers sealed containers. Each container shall be labelled by the manufacturer with the manufacturer's name, type of paint, batch number and colour.			
1.03.00	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.			
1.04.00	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.			
1.05.00	SURFACE PREPARATION			
1.05.01	All surfaces to be painted shall be thoroughly cleaned of oil. Grease and other foreign material. Surfaces shall be free of moisture and contamination from chemicals and solvents.			
1.05.02	The following surface preparation 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. SP1 Solvent cleaning SP2 Application of rust converter (Ruskil or equivalent grade) SP3 Power tool cleaning SP4 Shot blasting (shot blasting shall be used as surface preparation method for hot worked pipes prior to application of primer) SP4* Shot blast cleaning/ abrasive blast cleaning to SA21/2 (near white metal) 35-50 microns SP5 Shot blasting/ abrasive blasting. SP6 Emery sheet cleaning/Manual wire brush cleaning.			
1.06.00	APPLICATION OF PRIMER/PAINT			
1.06.01	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.			
1.06.02	Surfaces prepared as per the surface preparation scheme indicated herein shall be applied with primer paint within 6 hours after preparation of surfaces.			
1.06.03	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			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-B BID DOC. NO. CS-9585-001-2	SUB-SECTION - A-12 SURFACE PREPARATION & PAINTING	Page 1 of 9

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.06.04	as the surface is prepared. Primer coat shall be applied prior to intermediate and finish coats.			
1.06.05	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. Following are the Primer/painting schemes envisaged herein: PS3 - Zinc Chrome Primer (Alkyd base) by brush/Spray to IS104. PS3* - Zinc Chrome primer (Alkyd base) by dip coat. PS4 - Synthetic Enamel (long oil alkyd) to IS2932. PS5 - Red Oxide Zinc Phosphate primer (Alkyd base) to IS 12744 PS9 - Aluminium paint to IS 2339. PS9* - Heat resistant Aluminium paint to IS-13183 Gr.-1 PS13 - Rust preventive fluid by spray, dip or brush. PS14 - weldable primer-Deoxaluminate or equivalent. PS16 - High Build Epoxy CDC mastic `15' . PS17 - Aliphatic Acrylic Polyurethane CDE134 ,%V=40.0(min.) PS18 - Epoxy based TiO2 pigmented coat PS19 - Epoxy Zinc rich primer (92% zinc in dry film (min.), %VS=40.0(min.) PS-20 - Epoxy based finish paint			
1.06.06	All weld edge preparation for site welding shall be applied with one coat of wieldable primer.			
1.06.07	For internal protection of pipes/tubes, VCI pellets shall be used at both ends after sponge testing and ends capped. VCI pellets shall not be used for SS components and composite assemblies.			
1.06.08	SG membrane walls and other Flue gas swept pressure part surfaces shall be applied with appropriate primer for protection of surfaces during transit, storage and erection.			
1.06.09	a) All un-insulated equipments, pipes, valves etc covered in sub-section A-08 (Steam Turbine & Auxiliary system) shall be painted with paint not inferior to Epoxy resin based paints with minimum DFT of 150 micron. The paint shall be applied in three stages i.e. primer, intermediate and finish coats in following manner: ▪ Primer coat – Epoxy based zinc phosphate ▪ Intermediate - Epoxy based TiO2 pigmented coat ▪ Finish coat - Epoxy based finish coat b) Equipment, pipes etc. with high temperature shall be painted with heat resistant aluminum paint (to be selected based on the service condition of component as per IS-13183). Two coats of paint shall be applied with total DFT 40 micron. c) Surface preparation before painting shall be carried out according to requirement indicated in this sub-section and international standard			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-B BID DOC. NO. CS-9585-001-2	SUB-SECTION - A-12 SURFACE PREPARATION & PAINTING	Page 2 of 9

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.06.10	A) Specification for the application of Epoxy coating for internal protection of DM tank & other vessels/tanks (as applicable) shall be as follows: Primer : One coat of unmodified epoxy resin along with polyimide hardener. Paint : Two (2) coats unmodified epoxy resin along with Aromatic adduct hardener. Total thickness of primer and paint should not be less than 400 microns.			
	B) Specification for application of chlorinated Rubber paint for external protection vessel, tanks, piping, valves & other equipments shall be as follows: i) For Indoor vessel, tanks, piping, valves & other equipments: (a) Surface preparation shall be done either manually or by any other approved method. (b) Primer coat shall consist of one coat of chlorinated rubber based zinc phosphate primer having minimum DFT of 50 microns. (c) Intermediate coat (or under coat) shall consist of one coat of chlorinated rubber based paint pigmented with Titanium dioxide with minimum DFT of 50 microns. (d) Top coat shall consist of one coat of chlorinated rubber paint of approved shade and colour with glossy finish and DFT of 50 microns. Total DFT of paint system shall not be less than 150 microns. ii) For Outdoor vessel, tanks, piping, valves & other equipments: (a) Surface preparation shall be blast cleared using non-siliceous abrasive after usual wire brushing, which shall conform to Sa 2-1/2 Swiss Standard. (b) Primer coat shall consist of one coat of epoxy resin based zinc phosphate primer having minimum DFT of 100 microns. (c) Intermediate coat (or under coat) shall consist of epoxy resin based paint pigmented with Titanium dioxide with minimum DFT of 100 microns. (d) Top coat shall consist of one coat of epoxy paint suitable pigmented of approved shade and colour with glossy finish and DFT of 75 microns. Additionally finishing coat of polyurethane of minimum DFT of 25 microns shall be provided. The paint may be applied in one coat, in case high built paint is used, otherwise two coats shall be applied. Total DFT shall not be less than 300 microns.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART-B BID DOC. NO. CS-9585-001-2	SUB-SECTION - A-12 SURFACE PREPARATION & PAINTING	Page 3 of 9

1.06.11 Primer/Painting Schedule

Sl. No	Description		Surface Preparation	Primer Coat			Intermediate Coat			Finish Coats			Total Min. Painti ng DFT (Micr ons)	Colour Shade
				Type of Primer	No. of Coats	Min. DFT / coat (Microns)	Type of coating	No. Coats	Min. DFT/ Coat (Microns)	Type of coating	No. Coats	Min. DFT/ Coat (Microns)		
A) Power Cycle Piping														
1.	All insulated Pipings, fittings/ components, Pipe clamps, Vessels/Tanks, Equipments etc.		SP3/SP4	PS9*	1	20	-	-	-	PS9*	1	20	40	As per NTPC Colour shade/ coding scheme
2.	All un-insulated Pipings, fittings/ components, Pipe clamps, Vessels/Tanks, Equipments etc.	Design temperature < or equal to 60°C	SP3/SP4	PS 5	2	25	-	-	-	PS 4	3 \$	35 \$	155 \$	
		Design temperature above 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) and Variable Load Hanger (VLH)		SP4*	PS19	1	40	-	-	-	PS17	1	30	70	

4	Piping hangers/ supports (other than (3) above. (un-insulated)		SP4 (SP6 - for cleaning of weld joints after erection,)	PS 5	1	40	PS 4	1	40	PS 17	1	40	120
	Valves												
5.	Cast/Forge d	Design temperature < or equal to 60 degC	SP1/SP2/S P3	PS4/P S9	1	40	Polya mide Epoxy	1	100	PS17	1	40	180
		Design temperature above 60 degC and up to 200 degC	SP1/SP2/S P3	PS 9*	1	20	-	-	-	PS9*	1	20	40
		Design temperature above 200 degC	SP1/SP2/S P3	PS9*	1	20	-	-	-	PS9*	1	20	40
6.	All auxiliary Structural Steel components for pipe supports	Outside TG building and in SG envelope	SP4*	Inorga nic Ethyl Zinc Silicat e	1	75	PS18	1	75	a))Epoxy coat b)Final coat of paint PS17	2 1	35 30	250

		Within building	TG	SP4*	-do-	1	35	PS18	1	35	a))Epoxy coat b)Final coat of paint PS17	2 1	25 30	150	
7.	Weld Edges			SP6 (Hand cleaning by wire brushing)	PS13 (Weldable primer)	1	25	-	-	-	-	-	-	25	
1. \$ The first 2 finished coats (total min. DFT of 70 microns) shall be done at shop and the 3rd finish coat (min. DFT 35 Microns) shall be applied at site. 2. For valves below 65NB and temperature upto and including 540 DegC, Parkerizing/zinc phosphate corrosion resistant coating as per ASTM F1137 is also acceptable in lieu of Aluminum paint. 3. For corrosion protection of threaded hanger rods and variable spring cages, electro galvanizing in full compliance to minimum Corrosion category C3 as per EN ISO12944 is also acceptable. 4. For spring cages, 2 coats of 30 µm (min) zinc-rich epoxy resin primer with zinc content > 80 weight% in dry film followed by 2 coats of 30 µm (min) top coat of Acrylic resin Co-polymerisate with a total combined minimum DFT of 120µm is also acceptable in lieu of above specified paint scheme. 5. For corrosion protection for all inner parts of the hangers shall be at least in full compliance to Corrosion category C3 as per EN ISO12944.															
B) Steam Generator & Auxiliaries:															
1	All surfaces with temperature 95°C or less and which are insulated			SP3/SP4	PS 5	2	30	-	-	-	PS 4	2 \$	20 \$	100 \$	
2	All surfaces with temperature above 95°C and which are insulated			SP3/SP4	PS9*	1	20	-	-	-	PS9*	1	20	40	

Note: 1) SG membrane walls and other Flue gas swept pressure part surfaces shall be applied with appropriate primer for protection of surfaces during transit, storage and erection.

2) For valves below 65NB and temperature upto & including 545 Deg.C, Parkerizing/zinc phosphate corrosion resistant coating as per ASTM F1137 is also acceptable in lieu of Aluminum paint.

C) LOW PRESSURE PIPING

1	All Pipes, fittings / components, valves, Equipments etc.	SP3/SP5	PS3/ PS5	2	25	PS 4	1	30	PS 4	2	35	150	As per NTPC Colour shade/ coding scheme
2	Stainless steel surface, Galvanized steel surface and gun metal surface.	No Painting											
3	On the internal surface for pipes 1000 Nb and above	A coat of primer followed by hot coal-tar enamel or coal tar epoxy painting (cold) shall be applied.											

D) Fire Detection & Protection System, Compressed air system, Hydrogen generation plant and Air-conditioning & Ventilation System

For Fire Detection & Protection System, Surface preparation and painting of Fire Water Storage Tanks, all Steel Surfaces (external) exposed to atmosphere (outdoor & indoor installation), Deluge Valves, Alarm Valves, Foam monitors, Water monitors, Foam Proportioning equipments, Foam makers, etc. should be as per the Part-B, Sub Section-A-18, Fire Detection & Protection System

For Air Conditioning System, Surface preparation and painting of all the steel surfaces (external) exposed to atmosphere (outdoor & indoor installation), centrifugal fans – Casing etc. should be as per the Part-B, Sub Section-A-17, Air Conditioning System.

For Ventilation System, Surface preparation and painting of all the steel surfaces (external) exposed to atmosphere (outdoor & indoor installation), centrifugal fans – Casing etc. should be as per the Part-B, Sub Section-A-30, Ventilation System.

For compressed air system, Surface preparation and painting of all the steel surfaces should be as per the Part-B, Sub Section-A-16 compressed air system.

For hydrogen generation plant, Surface preparation and painting should be as per the Part-B, Sub-Section-A-19 hydrogen generation plant.

E) ESP

1	All surfaces with surface temperature 95°C or less (with insulation)	SP3/SP4	PS3/ PS5	1	25	-	-	-	PS 4	1	30	55
2	All surfaces with surface temperature above 95°C (with or without insulation)	SP3/SP4	PS5	2	30	-	-	-	-	-	-	60

General Notes (Applicable for all above points A to E)

- i) Painting specification for all surfaces with surface temperature 95°C or less (un-insulated) that are not covered above shall be same as that given in Civil Sub-section, Part-B, Section-VI for corrosion protection of steel structures.

EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)	BID DOC. NO. CS-9585-001-2	TECHNICAL SPECIFICATIONS SECTION VI, PART-B	TECHNICAL REQUIREMENTS	SUB-SECTION -A-12 Surface Preparation & Painting	Page 8 of 9



- ii) Painting specification for inside surfaces (such as inner surfaces of ducts/ tanks/ mills/ dampers/ ESP etc.) that are not covered specifically in above clauses, shall be provided with 2 coats of suitable primer i.e. PS5/ PS9 (Total DFT 60/40 micron) based on the temperature.

F) FGD System

- (i) Surface preparation shall be blast cleaned conforming to Sa 2-1/2 Swiss Standard.
- (ii) Primer coat shall consist of epoxy resin based zinc phosphate primer having minimum DFT of 100 microns.
- (iii) Intermediate coat (or under coat) shall consist of epoxy resin based paint pigmented with Titanium dioxide with minimum DFT of 100 microns.
- (iv) Top coat shall consist of one coat of epoxy paint suitable pigmented of approved shade and colour with glossy finish and DFT of 75 microns. Additionally finishing coat of polyurethane of minimum DFT of 25 microns shall be provided.

EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)	BID DOC. NO. CS-9585-001-2	TECHNICAL SPECIFICATIONS SECTION VI, PART-B	TECHNICAL REQUIREMENTS	SUB-SECTION -A-12 Surface Preparation & Painting	Page 9 of 9



TITLE :
3X800MW PATRATU TPP PHASE-1

**TECHNICAL SPECIFICATION FOR HYDROGEN
GENERATION PLANT**

SPECIFICATION NO. PE-TS-434-168-A001

SECTION : I

SUB-SECTION: IA

REV. NO. 00 **DATE :**

ANNEXURE VI: MANDATORY SPARES LIST



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S.No. Item		Quantity
1.01.00	Water Electrolyser	
a)	One (1) complete cell	1 Set
b)	All electronic Cards and power supply card for rectifiers	1 No. of each type
1.02.00	Spares for Compressors	
a)	Suction and discharge Valves (complete)	1 Set for each stage / size / type.
b)	Seats of suction and Discharge Valves	1 Set for each stage / size / type.
c)	Springs of suction and Discharge Valves	1 Set for each stage /size/type.
d)	Gaskets of suction and discharge valve	2 Sets for each stage /size/type.
e)	Bearings of Drive end, non-drive end, intermediate and motor	1 Set of each type /rating
f)	Piston rings (if applicable)	2 Sets of each stage/ type
g)	Diaphragm (if applicable)	2 Sets of each stage/ type
h)	Complete piston (if applicable)	1 Set of each stage/type
i)	V-Belts / Coupling	1 Set of each type
j)	Relief / Unloader assembly	1 No. of each stage/type
1.03.00	Feed water Valves	1 No. of each type/size
1.04.00	Filter element	2 Sets of each type /rating
1.05.00	Dryer desiccant	2 Complete fill
1.06.00 Blower		



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a)	Diaphram (if applicable)	2 Nos.
b) Belts		1 Set
1.07.00	Hydrogen manifold valves	4 Nos. of each type/ Size
	a) Complete hydrogen manifold fitted with valves.	1 Set
1.08.00	Adsorption filter elements with gaskets /O rings	2 Sets
1.09.00	Complete set of valves for isolation for filters, dryers, instruments and drain valves	1 No. of each type/rating
1.10.00	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
1.11.00	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.
1.12.00	Instrument spares	
(i)	Zenner barrier	2 nos.
(ii)	Limit switch	5% of each type
1.13.00	Oxygen analyser sensor	1 no. of each type
1.14.00	Miscellaneous instruments.	
(i)	Pressure switches	2 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
	Note : Wherever set is mentioned, one set of the spares of that item shall be for complete replacement of that particular item for one equipment	
1.15.00	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
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
e	Prefab cable	01 no of each type.
1.16.00	Motor for compressor	1 no.



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Note:-In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed as per the above list.



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ANNEXURE VII : DRAWING/DOCUMENTS SUBMISSION SCHEDULE



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S.NO.	DRAWING NO	DRG TITLE	APPROVAL CAT	SCH WEEK AFTER LOI	SIZE
1	PE-VO-434-168-A001	GENERAL ARRANGEMENT LAYOUT, FOUNDATION DETAILS AND FLOOR DRAIN DETAILS OF HYDROGEN GENERATION PLANT	A	4	A1
2	PE-VO-434-168-A002	PIPING & INSTRUMENTATION DIAGRAM WITH I/O LIST OF HYDROGEN GENERATION PLANT	A	4	A3
3	PE-VO-434-168-A003	DESIGN & CONTROL PHILOSOPHY OF H2 PLANT ALONG WITH INTERLOCK AND LOGIC DIAGRAM	A	6	A4
4	PE-VO-434-168-A004	GA HYDROGEN GENERATOR	A	6	A4
5	PE-VO-434-168-A005	DATA SHEET AND GA FOR COMPRESSORS WITH MOTOR OF HYDROGEN GENERATION PLANT	A	10	A4
6	PE-VO-434-168-A006	DATA SHEET, GA, & CIRCUIT DIAGRAM OF RECTIFIER TRANSFORMER OF HYDROGEN GENERATION PLANT	A	6	A4
7	PE-VO-434-168-A007	PLC DATASHEET, PLC-OWS/PRINTER FURNITURE BOM, PLC CATALOGUE, OWS & PRINTER CATALOGUES, PLC PANEL GA (INTERNAL & EXTERNAL), PANEL HEAT DISSIPATION DATA	A	12	A3
8	PE-VO-434-168-A008	GA OF FEED WATER, KOH TANK OF HYDROGEN GENERATION PLANT	A	6	A4
9	PE-VO-434-168-A009	GA OF H2 MANIFOLD OF HYDROGEN GENERATION PLANT	A	6	A4
10	PE-VO-434-168-A010	GA N2 PURGING MANIFOLD OF HYDROGEN GENERATION PLANT	A	6	A4
11	PE-VO-434-168-A011	GA HYDROGEN & NITROGEN CYLINDER OF HYDROGEN GENERATION PLANT	A	6	A4
12	PE-VO-434-168-A012	GA CYLINDER TEST STATION OF HYDROGEN GENERATION PLANT	A	6	A4
13	PE-VO-434-168-A013	GA VACUUM PUMP OF HYDROGEN GENERATION PLANT	A	6	A4
14	PE-VO-434-168-A014	PIPING INSTALLATION AND PIPING LAYOUT DRAWING	A	10	A1
15	PE-VO-434-168-A015	HYDROGEN PLANT INTER-LOCK LOGIC DIAGRAM & CONTROL SCHEMES (BLOCK LOGIC)	A	12	A4
16	PE-VO-434-168-A016	PLC INPUT / OUTPUT SIGNAL LIST, POWER SUPPLY WIRING DIAGRAM	A	12	A4
17	PE-VO-434-168-A017	ANNUNCIATOR PANEL WIRING DIAGRAM	A	12	A3
18	PE-VO-434-168-A018	H2 PLANT WIRING DIAGRAM	A	12	A3
19	PE-VO-434-168-A019	DATASHEET OF COMPRESSOR OF HYDROGEN GENERATION PLANT	A	10	A4
20	PE-VO-434-168-A020	DATASHEET OF INSTRUMENTS & ANALYSERS OF HYDROGEN GENERATION PLANT	A	10	A4
21	PE-VO-434-168-A021	DATASHEET OF MOTORS OF HYDROGEN	A	10	A4



TECHNICAL SPECIFICATION FOR HYDROGEN GENERATION PLANT	TITLE : 3X800MW PATRATU TPP PHASE-1		SPECIFICATION NO. PE-TS-434-168-A001	
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S.NO.	DRAWING NO	DRG TITLE	APPROVAL CAT	SCH WEEK AFTER LOI	SIZE
		GENERATION PLANT			
22	PE-VO-434-168-A022	DATASHEET OF PUMPS OF HYDROGEN GENERATION PLANT	A	10	A4
23	PE-VO-434-168-A023	CABLE SCHEDULE & INTERCONNECTION OF HYDROGEN GENERATION PLANT	A	16	A3
24	PE-VO-434-168-A024	DATASHEET OF VALVES ALONGWITH THE VALVE SCHEDULE OF HYDROGEN GENERATION PLANT	A	10	A4
25	PE-VO-434-168-A025	PIPE SCHEDULE OF HYDROGEN GENERATION PLANT	I	16	A3
26	PE-VO-434-168-A026	INSTRUMENT SCHEDULE OF HYDROGEN GENERATION PLANT	I	10	A4
27	PE-VO-434-168-A027	GA POWER DISTRIBUTION BOARD (MCC) OF HYDROGEN GENERATION PLANT	A	16	A1
28	PE-VO-434-168-A028	LIGHTING DESIGN/ LAYOUT FOR HYDROGEN GENERATION PLANT ALONG WITH PROTECTION SYSTEM	A	12	A1
29	PE-VO-434-168-A029	ELECTRICAL SLD OF PDB-MCC OF HYDROGEN GENERATION PLANT	A	16	A1
30	PE-VO-434-168-A030	ELECTRICAL LOAD DATA OF HYDROGEN GENERATION PLANT	I	10	A4
31	PE-VO-434-168-A031	PG TEST PROCEDURE OF HYDROGEN GENERATION PLANT	A	20	A4
32	PE-VO-434-168-A032	O&M MANUAL OF HYDROGEN GENERATION PLANT	A	24	A4
33	PE-VO-434-168-A033	SUB VENDOR LIST & INSPECTION CRITERIA OF HYDROGEN GENERATION PLANT	A	4	A4
34	PE-VO-434-168-A034	GA OF ELECTROLYSER AND PURIFICATION SKID.	A	6	A4
35	PE-VO-434-168-A035	INSTRUMENT HOOK UP, TRANSMITTER RACK GROUPINGS & FIELD JB TERMINATIONS	I	10	A3
36	PE-VO-434-168-A036	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA	I	10	A3
37	PE-VO-434-168-A037	LIST OF SIGNAL EXCHANGE WITH DDCMIS (BOTH HARDWIRED & SERIAL INTERFACE IN BHEL FORMAT)	A	10	A3
38	PE-VO-434-168-A038	PROCESS GRAPHIC MANUSCRIPTS PLC, PROCESS GRAPHIC MANUSCRIPTS FOR DDCMIS	A	10	A1
39	PE-VO-434-168-A039	UPS BATTERY CHARGER/ BATTERY DATASHEET, UPS SIZING CALCULATIONS, BATTERY SIZING CALCULATIONS, UPS QAP, UPS TYPE TEST REPORTS ON COMPONENTS CHOSEN	A	10	A3
40	PE-VO-434-168-A040	CABLE TRENCH/ TRAY LAYOUT AND EARTHING DETAILS FOR HYDROGEN GENERATION PLANT WITH DETAILS OF CABLE TRAY ACCESSORIES.	A	12	A1



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S.NO.	DRAWING NO	DRG TITLE	APPROVAL CAT	SCH WEEK AFTER LOI	SIZE
41	PE-VO-434-168-A041	QAP FOR COMPRESSORS WITH MOTOR OF HYDROGEN GENERATION PLANT	A	10	A4
42	PE-VO-434-168-A042	QAP FOR PLC OF HYDROGEN GENERATION PLANT	A	12	A4
43	PE-VO-434-168-A043	QAP OF RECTIFIER OF HYDROGEN GENERATION PLANT	A	6	A4
44	PE-VO-434-168-A044	QAP OF VALVES OF HYDROGEN GENERATION PLANT	A	10	A4
45	PE-VO-434-168-A045	QAP OF FEED WATER, KOH TANK	A	6	A4
46	PE-VO-434-168-A046	QAP OF ELECTROLYSER AND PURIFICATION SKID	A	6	A4
47	PE-VO-434-168-A047	QAP OF PUMPS WITH MOTOR OF HYDROGEN GENERATION PLANT	A	12	A4
48	PE-VO-434-168-A048	QAP FOR HYDROGEN GEN PLANT (BALANCE OF ITEM)	A	10	A4
49	PE-VO-434-168-A049	PLC QUALITY PLAN & FAT PROCEDURE	A	10	A4
50	PE-VO-434-168-A050	ERECTION PROCEDURE OF HYDROGEN GENERATION PLANT	I	16	A4
51	PE-VO-434-168-A051	ENGINEERING BOQ OF HYDROGEN GENERATION PLANT	A	20	A4

Notes:

1. A= APPROVAL. I = INFORMATION.
2. Any additional drawings-documents required during detailed engineering stage shall be provided by bidder without any commercial, technical and delivery implication to BHEL and customer.
3. Non-submission of the document as per attached schedule will attract LD.
4. Bidder to note that the successful bidder, during detail engineering, will submit the drg/doc through web based Document Management System in addition to hard copies to be submitted as per the Annexure IV of this specification. 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>)
 - DMS user manuals to be used by BHEL PEM vendors for uploading, viewing, revising, commenting and tracking documents on PEM's DMS have been uploaded on PEM internet website (www.bhelpem.com) under the Vendor session.
 - For quick access bidder may refer the link <http://bhelpem.com/DMSManuals/DMSManuals.html>



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ANNEXURE VIII: WATER ANALYSIS



TITLE :
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S.No.	Characteristics	Value
1.	Silica (Max.)	0.02 ppm as SiO ₂
2.	Iron as Fe	Nil
3.	Total hardness	Nil
4.	pH value	6.8 – 7.2
5.	Conductivity	Not more than 0.1 excluding the effects of free CO ₂



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ANNEXURE IX: LIST OF TOOLS & TACKLES (AS APPLICABLE)

Bidder to consider necessary tools and tackles for mechanical, electrical and control & instrument as per their system requirement. In addition bidder to adhere relevant clauses of tender specification also.



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ANNEXURE X: FORMAT FOR OPERATION AND MAINTENANCE MANUAL



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Bidder to submit operation and Maintenance manual with minimum information as listed in below check list during contract stage.

CHECK LIST FOR OPERATION & MAINTENANCE MANUAL

Project name :
 Project number :
 Package Name :
 PO reference :
 Document number :
 Revision number :

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
	1.1				
1.	1.2 Cover page				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2.0	1.3 Index				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	1.4 Description of Plant/System				
3.1	Description /write up of operating principle of system e quipment/ asso ciated sub-systems & accessories/controls system , o perating conditions, perfo rmance paramete rs under normal , start up and special cases				
3.2	Equipment list and basi c paramete r with Tag numbers				
3.3	Data sh eets approved by Cust omer/for information and catalo gues provided by origina l manufacturer				
3.4	Associated other p ackages a nd Interfa ce /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawin gs, As-built drawings , Actual photograph of items/syste m (Drawings of A2 & bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				
3.8	Control philosophy /control write-ups				
4.0	1.5 Commissioning Activities (if not covered in separate docu ment i.e. ere ction m anual,				



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	commissioning manual)				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	1.6 Operation Guidelines for plant personal/user/operator				
5.1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5.2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5.3	Do's & Don't of the equipments.				
5.4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5.5	Parameters to be monitored with normal values and limiting values				
5.6	Troubleshooting with causes and remedial measures				
5.7	Routine operational checks, recommended logs & records				
5.8	Changeover schedule if more than one auxiliary for the same purpose is given				
5.9	Painting requirement and schedule				
5.10	Inspection, repair, Testing and calibration procedures				
6.0	1.7 Maintenance guidelines for plant personal				
6.1	List of Special Tools and Tackles required for Overhaul/Troubleshooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenance and Overhaul. Storage/ handling requirement of consumables/self-life.				



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6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres, Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	Statutory and other specific requirements considerations.				
8.0	List of reference documents				
9.0	Binding as per requirement				



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ANNEXURE XI: SITE STORAGE AND PRESERVATION



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CONTENT

- 1 SCOPE OF THE DOCUMENT
- 2 PURPOSE OF STORAGE & PRESERVATION
- 3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION
 - a) GENERAL STORAGE REQUIREMENTS
 - b) GENERAL PRESERVATION REQUIREMENTS
 - c) GENERAL INSPECTION REQUIREMENTS
- 4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT
5. CONCLUSION
6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL



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1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. 'No smoking' signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,



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preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.



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10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.

11. Following preservatives/preservation methods can be used depending upon type of equipment

- a. Rust preventive fluid (RPF)
- b. Rust protective paints
- c. Tarpaulin covers, in case of outdoor storage
- d. De-oxy aluminate for weld-ments

c) **GENERAL INSPECTION REQUIREMENTS**

1. Period inspection of materials with specific reference to –

- Ingress of moisture and corrosion damages.
- Damage to protective coating.
- Open ends in pipes, vessels and equipment -
 - In case any open ends are noticed, same shall be capped.

2. Any damages to equipment / materials.

- In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
- Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.



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4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere. (C)**

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.



ii **Semi-closed storage. (S)**

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.





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iii Open storage (O)

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as "scrap yard" slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.





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The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
Raw material /mechanical items like pipes, plates, structure sections etc.)				
1.	Steel pipes (lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage ,	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
Fabricated mechanical items (pressure vessels, tanks etc.)				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles



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Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage, paint, corrosion	
19.	Flanges	C	Damage, paint, corrosion	
20.	Fabricated pipes	S	Damage, paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage, paint, corrosion, packing	
22.	Grills	S	Damage, paint, corrosion	
23.	Angles	S	Damage, paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage, paint, corrosion	
25.	Cranes, rails	S	Damage, paint, corrosion	
26.	Stair cases	O	Damage, paint, corrosion	
27.	Ladders/handrails	O	Damage, paint, corrosion	
28.	Fabricated ducts	S	Damage, paint, corrosion	
29.	Isolation Gates	O	Damage, paint, corrosion	
30.	Fabricated boxes/panels	S	Damage, paint, corrosion	
Mechanical components like valves, fittings, cables glands, spares etc.)				
31.	Valves	S	Damage, packing	



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Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H ₂ SO ₄)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical



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Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moisture, rain
74.	Alum bricks	C	Damage to packing	Prevent moisture, rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals(powder)	C	Damage, Packing self-life	
77.	Laboratory chemicals(liquid)	C	Damage, Packing self-life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	



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Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
Electrical and C & I items (motors, cables etc.)				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments(gauges/analysers)	C	Damage	
Special items		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		



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5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.



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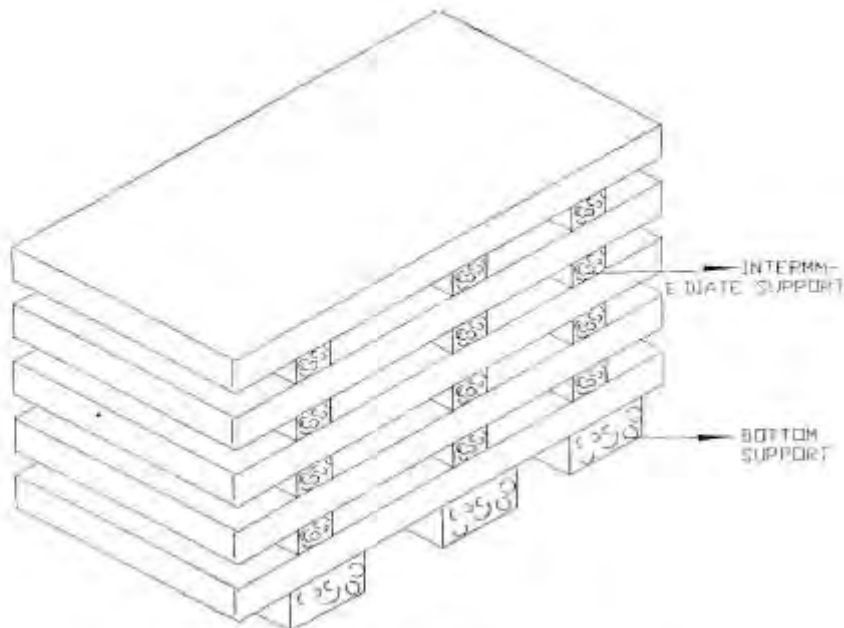


Figure – 1 – PLATE STACKING ARRANGEMENT

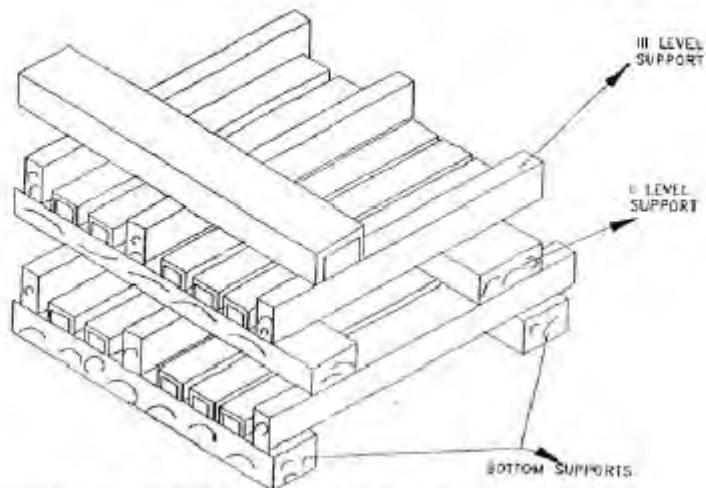


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT



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ANNEXURE XIII -GUARANTEED PERFORMANCE DATA



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S.no.	Description	Parameter
1.	Hydrogen generation plant minimum capacity (Nm3/hr.)	12
2.	Number of streams (2X50%)	2
3.	Minimum Capacity of each streams/electrolyser (Nm3/hr.)	6
4.	Hydrogen purity (%) at gas manifolds	99.99
5.	Moisture content in hydrogen- gm/m3 (max)	0.05
6.	Design delivery pressure at its rated duty point in Kg/cm2 (g)	150
7.	Minimum capacity of each compressor (Nm3/hr.)	125% of rated Capacity of each streams (Nm3/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).



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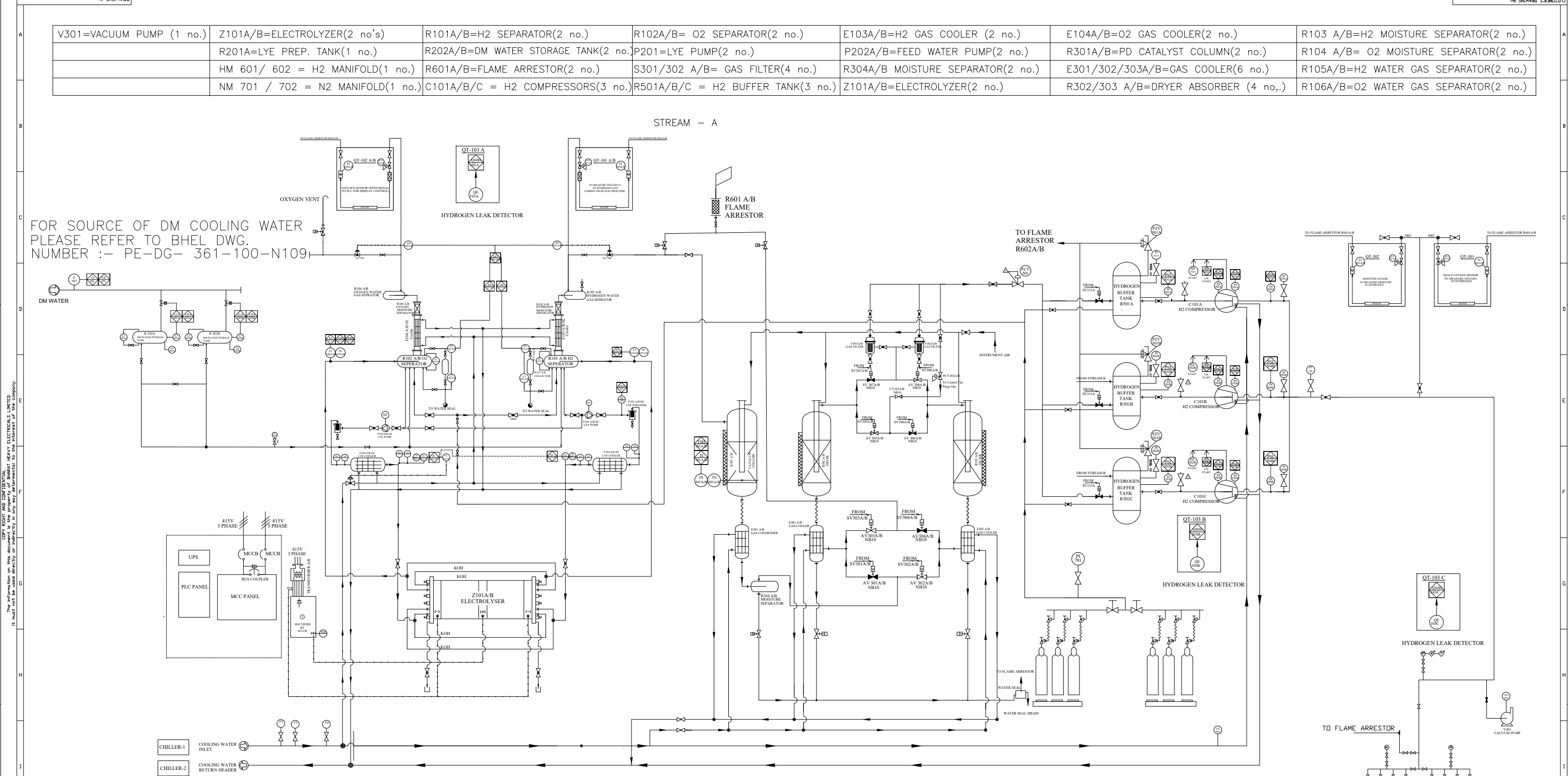
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P&ID & EQUIPMENT LAYOUT



NOTES

LEGEND

TABLES

1. ANY OTHER INSTRUMENT & DEVICES REQUIRED FOR EFFICIENT & SAFE OPERATION OF PLANT SHALL BE SUPPLIED.

2. NO. OF STAGES IN COMPRESSOR SHALL BE AS PER INLET/OUTLET PRESSURE REQUIREMENT AS PER MANUFACTURERS PRACTICE /PROCESS.

3. THERE MAY BE MINOR CHANGES IN THE P&ID AS PER MANUFACTURER STANDARD PRACTICE TO SUIT MANUFACTURERS PROCESS DESIGN.

4. A LOOSE PVC LYE PREPARATION TANK SHALL BE SUPPLIED WITH THE HYDROGEN GENERATION PLANT FOR PRPARATION OF THE KOH SOLUTION . THE WATER REQUIRED FOR PRPARING SOLUTION SHALL BE TAKEN BY OPERATING DRAIN VALVE OF FEED WATER TANK.

5. PASSIVATED DM WATER SHALL BE USED FOR COOLING OF ELECTROLYSER AND COMPRESSOR IN CLOSED LOOP WITH MAKE UP AS DM WATER.

6. FOR INSTRUMENTS OUTSIDE THE EQUIPMENT SKIDS REDUNDANCY IN TRANSMITTERS AND SWITCHES FOR FOR THE INTERLOCK SHALL BE PROVIDED.

TABLES

TABLE 1: Equipment List

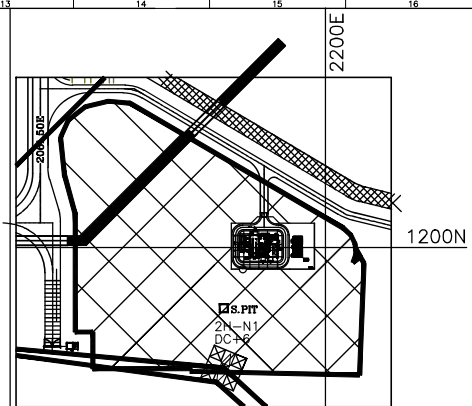
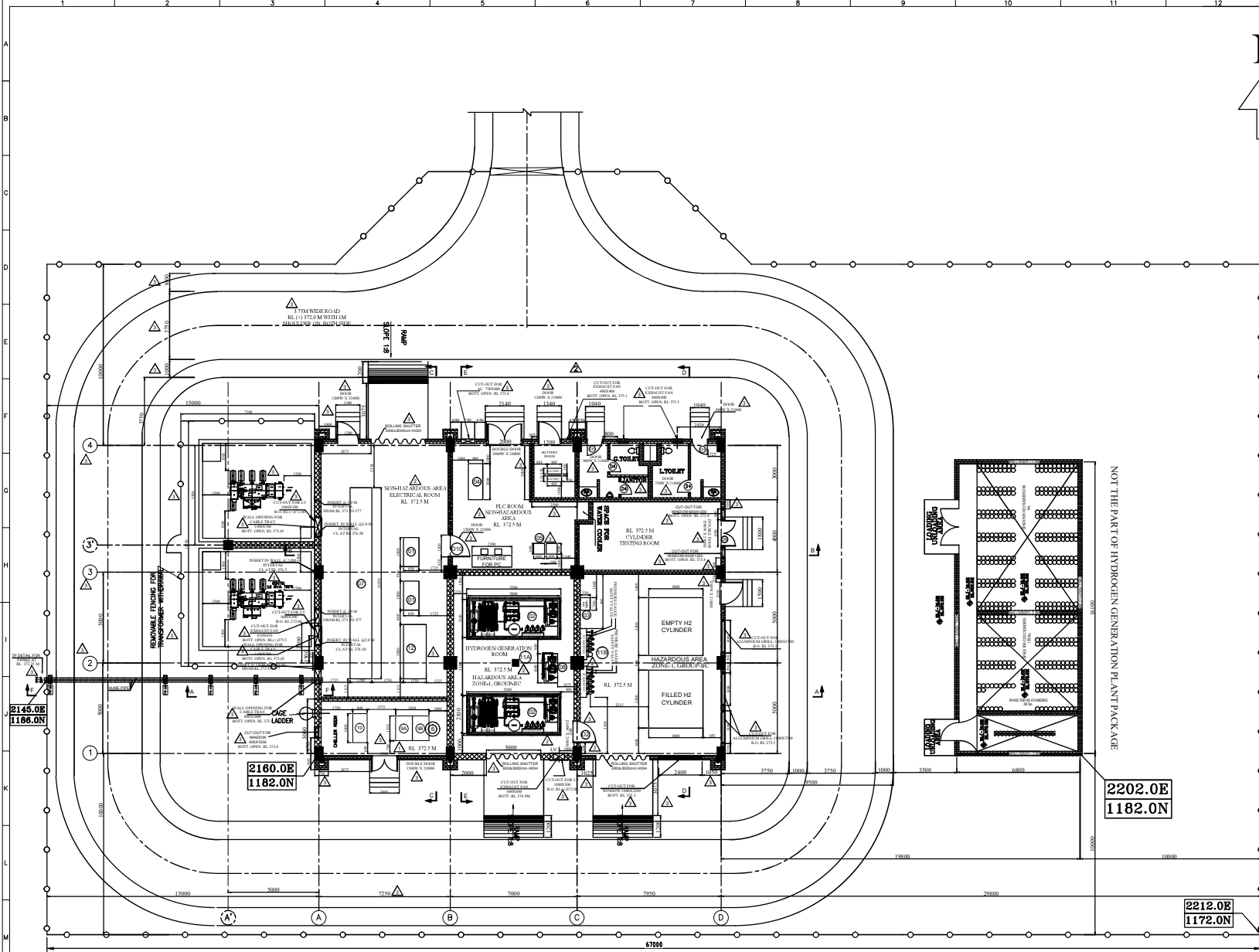
TABLE 2: Instrument List

TABLE 3: Material List

TABLE 4: Piping Schedule

TABLE 5: Welding Symbols

TABLE 6: Drawing Information



KEY PLAN

INFORMATION FOR EQUIPMENT			
Sr. No.	EQUIPMENT NAME	Load in KG (Each)	QTY.
1	RECTIFIER PANEL - A/B	FOUNDATION NOT REQUIRED	2
2	ELECTROLYSER WITH GAS SEPARATION AND H2 PURIFIER, COMPRESSOR	6500	2
3	VACUUM PUMP	60	1
4	PLC PANEL	FOUNDATION NOT REQUIRED	1
5	BATTERY CHARGER	FOUNDATION NOT REQUIRED	2
6	DM WATER STORAGE TANK (ON ROOF)	FOUNDATION NOT REQUIRED	1
7	MCC PANEL (BHEL SCOPE)	-	1
8	STAND BY H2 COMPRESSOR	1000	1
9	CHILLER A/B	450	2
10	INSTRUMENT AIR COMPRESSOR (10m³/h)	-	1
11	HYDROGEN LEAK DETECTOR	-	2
12	ACN-LDB PANEL	-	1

- NOTES:
- All dimension are in mm and levels are in meter, unless otherwise specified.
 - Gases will be discharged at height of 1m from top of building
 - In cylinder filling & storage area, there shall be parapet wall of 230mmx800mm and after 800 mm parapet wall there will be aluminium grill till top of the room.
 - Inverted beams shall be considered is hydrogen generation building.
 - F.F.L of HGP Building is EL(-)3.00M / RL 372.5M

- SAFETY NOTES:-
- Hazardous Area
 - Hydrogen generation room is monitored for the presence of hydrogen in air
 - Adequate ventilation via aluminium grill and/or features is provided to prevent accumulation of h2 near the roof
 - Equipment / instrument in this area shall be explosion/flameproof
 - Non-Hazardous Area - Hazardous material is not handled in this area
 - Separation of this area from other area is via walls
 - Use appropriate safety measures in handling hazardous material/ equipment refer operational, manual.

- REFERENCE DRAWING NO AND NAME
- 9585-001-110-PVM-L-452 :- P & ID DIAGRAM FOR H2 PLANT
 - 9585-001-110-PVE-F-476 :- CABLE TRAY TRENCH LAYOUT FOR HYDROGEN GENERATION PLANT
 - 9585-001-110-PVM-B-462 :- GA OF ELECTROLYSER SKID
 - 9585-001-110-PVM-F-467 :- VENTILATION SYSTEM CALCULATION & LAYOUT FOR HGP

3	19.05.20	G.R	JM	AKA	REVISED AS PER COMMENTS
2	21.08.19	D.S	JM	AKA	REVISED AS PER COMMENTS
1	19.02.19	D.S	JM	AKA	REVISED AS PER COMMENTS
0	25.01.19	D.S	JM	AKA	FIRST SUBMISSION
DATE ALTERED CHECKED APPROVED					NOTE

PROJECT 3X300MW PVUNL PATRATU TPP PHASE-1 (EPC)

(EPC MAIN PLANT PACKAGE)

OWNER: PATRATU VIDYUT UTPADAN NIGAM LIMITED

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECTS ENGINEERING MANAGEMENT, NEW DELHI

AIROX NIGEN EQUIPMENTS PVT. LTD.

SCALE: 1/20

TITLE: EQUIPMENT AND BUILDING LAYOUT FOUNDATION DETAILS AND LAYOUT TRAIN DETAILS OF H2 GENERATOR PLANT

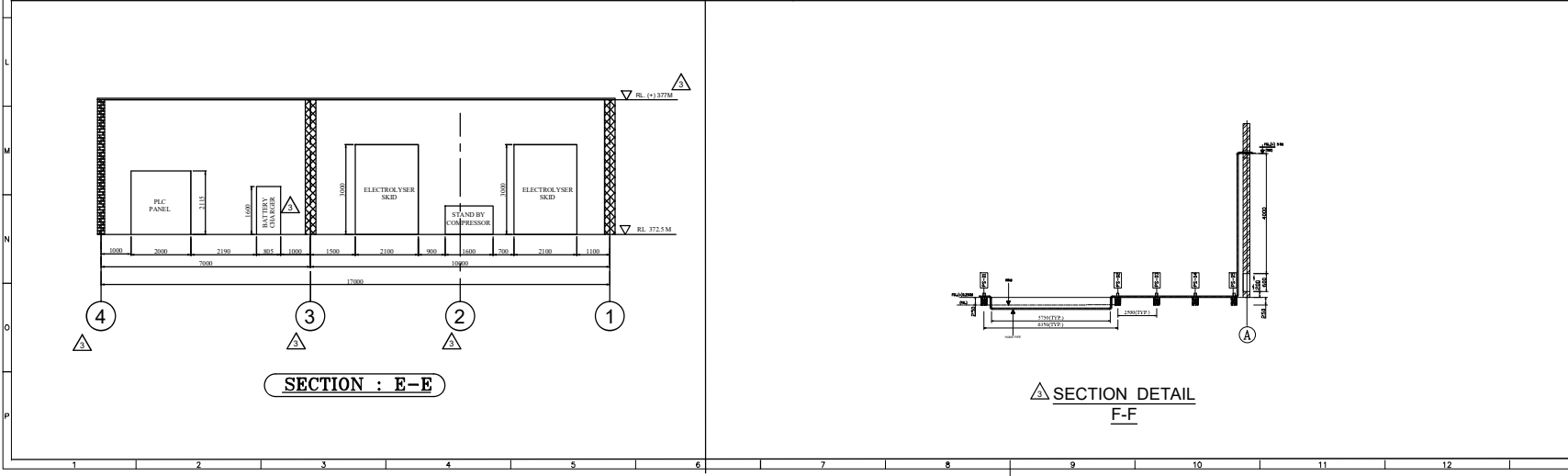
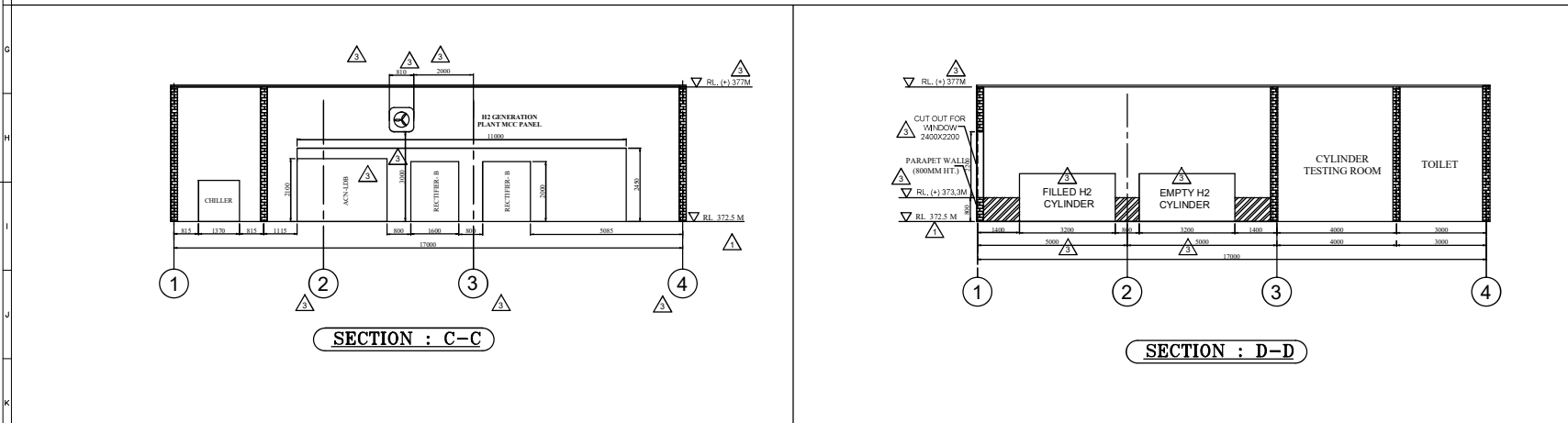
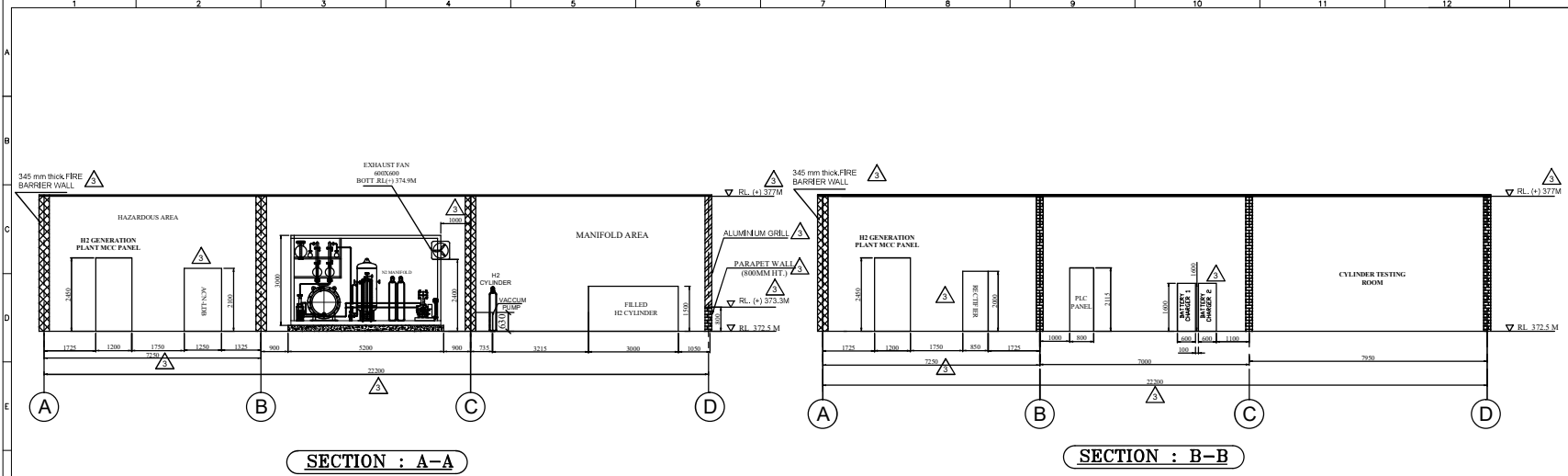
DESIGNED BY: DATE: 19.05.2020 NAME: OR: JN

CHECKED BY: 19.05.2020 JN
APPROVED BY: 19.05.2020 AKA
SUPERSEDED BY: PROJECT NO: NTPC SRG NO. 9585-001-110-PVM-F-468
SYSTEM: GAS CHLORINATION SYSTEM ANNEX: DRAWING NO: PE-VB-434-168-467

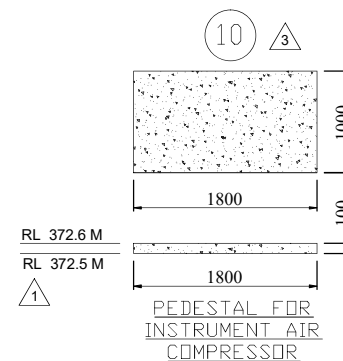
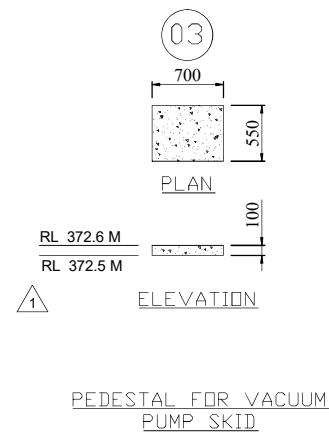
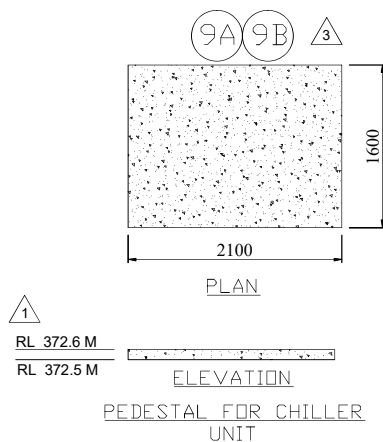
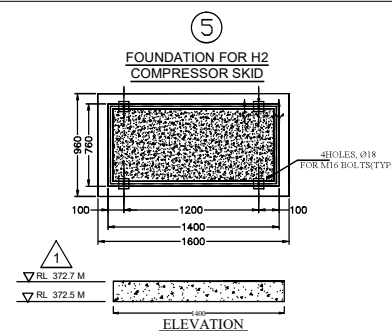
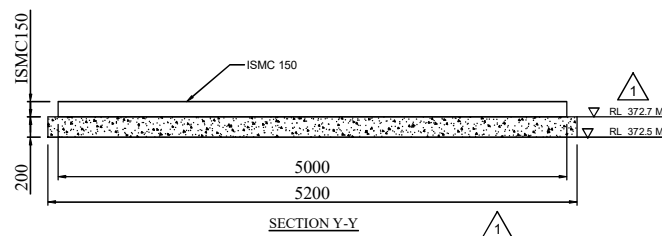
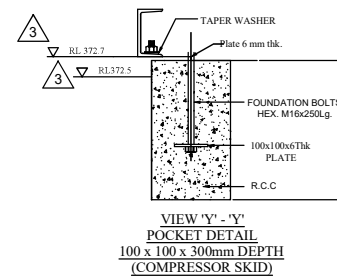
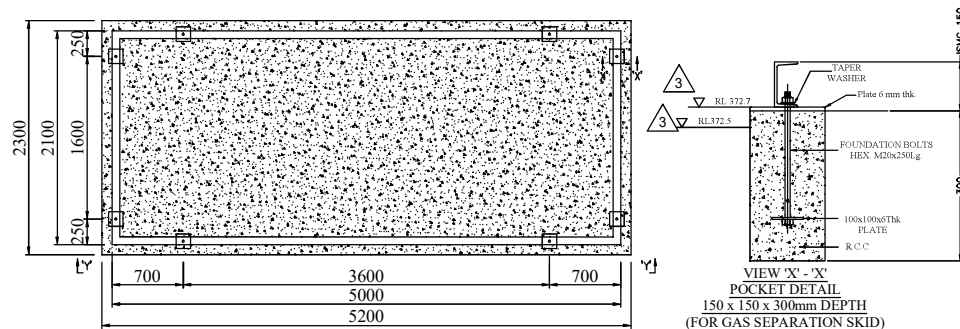
PIPING TERMINAL POINT DETAIL		
TP POINT	DESCRIPTION	SIZE
TP 01	SERVICE WATER	50NB
TP 02	POTABLE WATER	50NB
TP 03	DM WATER	25NB

LEGEND	
(D)	DOOR HERE
(RS)	ROLLING SHUTTER
	230mm THK. PARAPET WALL
	345mm THK. BRICK WALL
	ALUMINIUM GRILL

3
3



3	19.05.20	G.R	JM	AKA	REVISED AS PER COMMENTS
2	21.08.19	D.S	JM	AKA	REVISED AS PER COMMENTS
1	19.02.19	D.S	JM	AKA	REVISED AS PER COMMENTS
0	25.01.19	D.S	JM	AKA	FIRST SUBMISSION
DATE ALTERED CHECKED APPROVED					NOTE
PROJECT 3X800MW PVUNL PATRATU TPP PHASE-1 (EPC)					
(EPC MAIN PLANT PACKAGE)					
OWNER: PATRATU VIDYUT UTPADAN NIGAM LIMITED					
DESIGNED BY: BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECTS ENGINEERING MANAGEMENT, NEW DELHI					SCALE: INTS SHEET 2 OF 3
DRAWN BY: AIROX NIGEN EQUIPMENTS PVT. LTD.					
TITLE: EQUIPMENT AND BUILDING LAYOUT FOUNDATION DETAILS AND FLOOR BRAIN DETAILS OF H2 GENERATOR PLANT					
SUPERSEDED BY:		SIZE: A3	PROJECT NO:	NTPC BRG NO. 9583-001-110-PVH-F-468	
SYSTEM: GAS CHLORINATION SYSTEM		ANNO:	DRAWING NO:	PE-VB-434-168-A017	
				15	03



NOTES:-

1) ALL ELECTRICAL PANEL SHALL BE MOUNTED ON CABLE TRENCH CIVIL FOUNDATION NOT REQUIRED FOR PANELS.

2) FOUNDATION POCKET NOT REQUIRED FOR VACUUM PUMP.

3	19.05.20	G.R	JM	AKA	REVISED AS PER COMMENTS
2	21.08.19	D.S	JM	AKA	REVISED AS PER COMMENTS
1	19.02.19	D.S	JM	AKA	REVISED AS PER COMMENTS
0	25.01.19	D.S	JM	AKA	FIRST SUBMISSION
	DATE	ALTERED	CHECKED	APPROVED	NOTE
PROJECT 3X300MW PVUNL PATRATU TPP PHASE-1 (EPC)					
(EPC MAIN PLANT PACKAGE)					
OWNER: PATRATU VIDYUT UTPADAN NIGAM LIMITED					
BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECTS ENGINEERING MANAGEMENT, NEW DELHI					
AIROX NIGEN EQUIPMENTS PVT. LTD.					
DRAWN BY	DATE	NAME	OR	TITLE	
DESIGN BY	DATE	NAME	OR	EQUIPMENT AND BUILDING LAYOUT FOUNDATION DETAILS AND LUGGERS BRAIN DETAILS OF H2 GENERATOR PLANT	
CHECKED BY	DATE	NAME	OR		
APPROVED BY	DATE	NAME	OR		
SUPERSEDED BY	DATE	NAME	OR		
SYSTEM	GAS CHLORINATION SYSTEM	SIZE	A3	PROJECT NO.	NTPC SRG NO. 9583-001-110-PVH-F-468
ANNEX		DRAWING NO.	PE-VB-434-168-A017		

	TITLE : 3X800MW PATRATU TPP PHASE-1		SPECIFICATION NO. PE-TS-434-168-A001	
	TECHNICAL SPECIFICATION FOR HYDROGEN GENERATION PLANT		SECTION : I	
			SUB-SECTION:IB	
			REV. NO. 00	DATE :

SUB-SECTION IB - SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)

	TITLE :		SPECIFICATION NO. PE-TS-434-168-A001
	3X800MW PATRATU TPP PHASE-1		SECTION : I
	TECHNICAL SPECIFICATION FOR HYDROGEN GENERATION PLANT		SUB-SECTION:IB
			REV. NO. 00 DATE :

1.0 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 equipment.
- d) Electrical load requirement for Hydrogen Generation Plant
- e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL
- g) Various drawings, 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.
- h) Motor shall meet minimum requirement of motor specification.
- i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
- j) Cable BOQ worked out based on routing of cable listing provided by the vendor for “both end equipment in vendor’s scope” shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer “Electrical Scope between BHEL and Vendor”.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- 3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.
- 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.

	TITLE : 3X800MW PATRATU TPP PHASE-1		SPECIFICATION NO. PE-TS-434-168-A001	
	TECHNICAL SPECIFICATION FOR HYDROGEN GENERATION PLANT		SECTION : I	
			SUB-SECTION:IB	
			REV. NO. 00	DATE :

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE : HYDROGEN GENERATION PLANT

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT:

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) 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. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	BHEL BHEL BHEL	BHEL Vendor BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, optical fibre etc.	Vendor	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
6	Cable trays, accessories & cable trays supporting system 100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling	BHEL Vendor	BHEL Vendor	Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage.
7	Cable glands ,lugs and bimetallic strip for equipment supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power and control cables.
8	Conduit and conduit accessories for cabling between equipment supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
9	Lighting	BHEL	BHEL	
10	Equipment grounding (including electronic earthing) & lightning protection	BHEL	BHEL	Refer note no. 4 for electronic earthing

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE : HYDROGEN GENERATION PLANT

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT:

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
11	Below grade grounding	BHEL	BHEL	
12	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
15	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
16	a) Input cable schedules (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Electrical Equipment & cable tray layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish Electrical equipment layout & cable tray layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Cabling arrangement of the same (wherever overhead cable trays, trenches, cable ducts, conduits etc.) shall be decided during contract stage. Electrical equipment layout & cable tray layout drawing shall be subjected to BHEL/ customer approval without any commercial implications to BHEL. Vendor to ensure the cable tray lay out shall confirm to NFPA (National fire prevention act)/TAC (Tariff advisory committee) applicable for hazardous area classification.
18	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE : HYDROGEN GENERATION PLANT

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT:

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.
4. Vendor shall indicate location of Electronic Earth pit in their Civil assignment drawing.

	TITLE : 3X800MW PATRATU TPP PHASE-1		SPECIFICATION NO. PE-TS-434-168-A001	
	TECHNICAL SPECIFICATION FOR HYDROGEN GENERATION PLANT		SECTION : I	
			SUB-SECTION:IB	
			REV. NO. 00	DATE :

ELECTRICAL LOAD DATA FORMAT

LOAD TITLE	RATING (KW/A)		UNIT (U)/STN(S)	Nos.		VOLTAGE CODE	FEEDER CODE	EMER. LOAD(Y)	CONT. (C)/INTT.(I)	STARTING TIME <5 SEC(Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. NO.	CONTROL CODE	REMARKS	LOAD No.
	NAME PLATE	MAX.CON T.DEMAN D(MCR)		RUNNING	STANDBY								SIZE CODE	Nos				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
STREAM 1																		
Rectifier	33	57.38891	S	1		D	S	N	C		INDOOR							
H2 Compressor	3.7	6.434514	S	1		D	U	N	C		INDOOR							
DM Water cum lye Pump	0.75	1.304293	S	1		D	U	N	I		INDOOR							
Lye Circulation Pump	0.75	1.304293	S	1		D	U	N	C		INDOOR							
Heater (Catalyst Column)	2	10.86957	S	1		E	S	N	C		INDOOR							
Dryer Heater	2	10.86957	S	1		E	S	N	C		INDOOR							
Dryer Heater	2	10.86957	S	1		E	S	N	C		INDOOR							
STREAM 2																		
Rectifier	33	57.38891	S	1		D	S	N	C		INDOOR							
H2 Compressor	3.7	6.434514	S	1		D	U	N	C		INDOOR							
DM Water cum lye Pump	0.75	1.304293	S	1		D	U	N	I		INDOOR							
Lye Circulation Pump	0.75	1.304293	S	1		D	U	N	C		INDOOR							
Heater (Catalyst Column)	2	10.86957	S	1		E	S	N	C		INDOOR							
Dryer Heater	2	10.86957	S	1		E	S	N	C		INDOOR							
Dryer Heater	2	10.86957	S	1		E	S	N	C		INDOOR							
COMMON																		
Vacuum Pump	1.11	1.930354	S	1		D	U	N	I		INDOOR							
UPS/Battery Charger -1	5	8.695289	S	1		D	S	N	C		INDOOR							
UPS/Battery Charger -2	5	8.695289	S	1		D	S	N	C		INDOOR							
Cylinder Testing Apparatus																		
a) Heater	2	6.024096	S	1		E	S	N	I		INDOOR							
b) Pump	3.7	6.434514	S	1		D	U	N	I		INDOOR							
c) Blower	2	3.478116	S	1		D	U	N	I		INDOOR							
Exhaust Fan 1	1.5	2.608587	S	1		D	U	N	C		INDOOR							
Exhaust Fan 2	1.5	2.608587	S	1		D	U	N	C		INDOOR							
Exhaust Fan 3	1.5	2.608587	S	1		D	U	N	C		INDOOR							
Exhaust Fan 4	1.5	2.608587	S	1		D	U	N	C		INDOOR							
Exhaust Fan 5	1	5.434783	S	1		E	S	N	C		INDOOR							
Exhaust Fan 6	1	5.434783	S	1		E	S	N	C		INDOOR							
Exhaust Fan 7	1	5.434783	S	1		E	S	N	C		INDOOR							
AC 1	4	21.73913	S	1		E	S	N	C		INDOOR							
AC 2	4	21.73913	S	1		E	S	N	C		INDOOR							
Chiller (W)	5	8.695289	S	1		D	S	N	C		INDOOR							
Chiller (S)	5	8.695289	S		1	D	S	N	C		INDOOR							
Instrument air compressor	5	8.695289	S	1		D	U	N	C		INDOOR							
Hydrogen gas compressor (S)	3.7	6.434514	S		1	D	U	N	C		INDOOR							
NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL) 2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V : ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)																		
LOAD DATA (ELECTRICAL)	JOB NO.		9585-001-110-PVE-H-471									ORIGINATING AGENCY		PEM (ELECTRICAL)				
	PROJECT TITLE		3 X 800 MW PATRARU STPP									NAME						
	SYSTEM / S		H2 GEN. PLANT									SIGN.		DATA FILLED UP ON DATA ENTERED ON				
	DEPTT. / SECTION		ELECTRICAL									SHEET 1 OF 1		REV 00		DE'S SIGN. & DATE		

ANNEXURE III

142

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT_CAB_SCH_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
 - a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
 - b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
 - f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
 - g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

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

(A) SYSTEM VOLTAGE CODES:

(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V
 (dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) CABLE VOLTAGE CODES:

A = 11KV (Power cables)

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

B = 6.6KV (Power cables)
C = 3.3KV (Power cables)
D = 1.1KV (LV & DC system power & control cables)
E = 0.6KV (0.5 sq. mm. Control cables)

(C) CABLE CODES

PVC Copper

A = Armoured FRLS	B = Armoured Non-FRLS
C = unarmoured FRLS	D = Unarmoured Non-FRLS

PVC Aluminium

E = Armoured FRLS	F = Armoured Non-FRLS
G = unarmoured FRLS	H = Unarmoured Non-FRLS

XLPE Copper

J = Armoured FRLS	K = Armoured Non-FRLS
L = unarmoured FRLS	M = Unarmoured Non-FRLS

XLPE Aluminium

N = Armoured FRLS	P = Armoured Non-FRLS
Q = unarmoured FRLS	R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES
T = TOUGH RUBBER SHEATH
U = OVERALL SCREENED
V = PAIRED OVERALL SCREENED
W = PAIRED INDIVIDUAL SCREENED
Y = COMPENSATING CABLES
I = PRE-FABRICATED CABLES
Z = JELLY FILLED CABLES

	TITLE : 3X800MW PATRATU TPP PHASE-1		SPECIFICATION NO. PE-TS-434-168-A001	
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			SUB-SECTION:IC	
			REV. NO. 00	DATE :

SPECIFIC TECHNICAL REQUIREMENTS (CONTROL & INSTRUMENTATION)



C&I SPECIFICATION FOR HYDROGEN GENERATION PLANT

SECTION: C
SUB SECTION: C&I

Specific Technical Requirements (C&I):

1. The controls for Hydrogen Generation Plant shall be realized in PLC based control. The PLC shall be in bidder's scope of supply.
2. The Contractor shall provide complete Instrumentation for control, monitoring and operation of entire Hydrogen Generation Plant. The requirements given are to be read in conjunction with detailed Technical specification enclosed in the specification. Further in case of any discrepancy in the requirement within the same section noted by the bidder in the specification, the same will be brought to the notice of BHEL in the form of pre-bid clarification. In absence of any pre-bid clarification, the more stringent requirement as per interpretation of customer shall prevail without any commercial implication.
3. PLC based control system shall be provided with hot redundant processors.
4. Plant schematic for monitoring & operation shall be available on OWS, bidder to further submit list of important signal along with applicable schematic for monitoring in DCS.
5. The Hydrogen generation plant shall include all Primary and Secondary Instruments, Local control panels. All instruments required for the package shall be supplied, mounted on the gauge board racks, along with accessories like impulse pipe, fittings & valve manifolds etc.
6. The make/model of various instruments/items/systems shall be as per NTPC approved vendor list. No commercial and delivery implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.
7. Time synchronization of PLC with DCS is to be carried out. Necessary hardware/software for same at PLC end to be provided by vendor.
8. The UPS system and 24VDC Supply for PLC is in bidder scope please refer specification for details.
9. PLC shall be connected to DCS (in BHEL Scope of supply) through OFC with MODBUS Protocol for monitoring.
10. Vendor shall provide at least 20% or minimum one no. spare channels as hot-on-rail spares in each configured cards/modules. In addition to this 10% or minimum one no. extra assigned complete spare cards mounted on rails in sub-racks for each type of I/O modules shall also to be provided.
11. Each PLC has to be accompanied by a LIU (Light interface unit/Fibre patch chord) which has multi/single mode SC couplers / adapters (in the bidder's scope).
12. Soft link communication between PLC & DDCMIS shall be redundant Bi-directional OPC link. Bidder shall include required hardware at PLC end. The protocol between PLC & DDCMIS shall be TCP/IP Ethernet & the maximum communication time for receipt of signal at DDCMIS end should not exceed 2 seconds.



**C&I SPECIFICATION FOR
HYDROGEN GENERATION PLANT**

SECTION: C
SUB SECTION: C&I

13. Two OEWS and One number A4 size color laser printer at hydrogen generation plant control room shall be provided as a part of the HMIS system. It shall print out all alarm/trip conditions and event changes in plant status along with date and time of occurrence. Furniture (chair, table, Amirah etc) in the local control room to be provided by vendor.
14. Connected data cable for PLC to remote I/O panels shall be through redundant cable/optic fibers with redundant I/O.
15. VMS (VIBRATION MONITORING SYSTEM) for HT drive shall be in bidder scope, details of the same is included in specification.
16. In case the above referred type of data-link is not envisaged, kindly specify to the PLC vendor to make provision to accept either IRIG-B (Amplitude Modulated Type B122) signal or a PPS/PPM pulse input directly from our Master clock system. The IRIG-B signal shall be transmitted over a Co-axial cable and BNC terminal to receive it shall be needed on the PLC / PLC-PC. The PPS/PPM signal shall be transmitted over UTP cable.
17. If PLCs are to be connected to the DCS for data transfer, and that too thru' a network switch, we shall be providing an SNTP time sync signal from our GPS based Master/Slave clock system - extended upto the network switch in BHEL-EDN scope. The PLC vendor to make provision to accept the same over the data link itself (usually at the PLC system end there will be a PC or network switch thru' which the SNTP time sync signal is not only displayed on their PCs but also routed to their PLC controllers using their own proprietary time sync software feature available by default in their system).
18. All instruments and control elements shall be terminated on JB/LCP in field and both instrument and JB/LCP are in bidder scope. Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 12-15 mtrs) and trunk cable.
19. For cable scope refer to electrical scope between BHEL and vendor defined in electrical specification.
20. Bidder to provide mandatory spares as per mandatory spares list.
21. Electrical Actuators with integral starter shall be provided for all on/off and inching type valves along with necessary interface units for linking to corresponding Control System as applicable, typical Hook-up diagram of drives is included for reference.
22. The specifications for instruments mentioned in the specification are minimum requirements. The detail specifications shall be finalized during detail engineering.
23. The bidders shall specifically mention any deviation they would like to take on the C&I specification. In absence of only deviation, a No deviation certificate is to be furnished.
24. The quantity of instruments for the 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 the instruments and devices that are needed for the completeness



C&I SPECIFICATION FOR HYDROGEN GENERATION PLANT

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of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.

25. Bidder to terminate all instrumentation and control elements in junction boxes. Bidder to provide input/output list, drives list, junction box schedule and termination details, recommended control logics / write-up etc. the list of documents to be submitted after award of contract is to be referred by bidder.
26. All the transmitters supplied by Bidder shall be rack mounted. The transmitter racks shall be in Bidder's scope of supply. All transmitters shall be HART compatible.
27. Bidder to perform tests of C&I items/instruments/systems as per Quality plans/type test attached in the specification. However, if any test not specified in the quality plan but specified in specification Tests for I&C equipment included elsewhere in specification will have to perform by Bidder without any cost implication. The make/model of various instruments/items/systems shall be as per customer/BHEL approved vendor list. No commercial and delivery implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.
28. Instrument installation and accessories required for the same shall be in Bidder's scope and shall be submitted after award of contract. However, any instrument/ analyser installation not covered in the same shall be subject to customer and BHEL approval during detailed engineering.
29. All Temperature sensors shall be Duplex type and temperature transmitter shall be provided for all temperature measurement applications. Bidder to provide temperature transmitter along with compensating cable, JB/Rack & other erection hardware.
30. UPS Power supply shall be provided by bidder.
31. Contractor shall furnish Instrument Schedule, I/O list, Drive list, Cable Schedule, Cable interconnection (DCS end terminal details shall be provided to vendor during detail engineering to incorporate in cable interconnection), JB grouping, Annunciation list, SOE list, List of Instruments/devices for HART in BHEL approved format. Also reusable database format like MS Excel, MS Access etc. of these documents shall also be provided by Contractor in BHEL approved format. Soft copy of the formats shall be provided to the successful bidder.
32. Bidder to perform tests of C&I items/instruments/systems as per Quality plans/type test attached in the specification. However, if any test not specified in the quality plan but specified in specification Tests for I&C equipment included elsewhere in specification will have to perform by Bidder without any cost implication.
33. Instrument installation and accessories required for the same shall be in Bidder's scope and shall be submitted after award of contract. However, any instrument/ analyzer installation not covered in the same shall be subject to customer and BHEL approval during detailed engineering.



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SECTION: C
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34. Interface of MCC, HT SWGR, Solenoid valves, field instruments, Actuators etc. with DDCMIS based control system shall be as per Drive Control Philosophy enclosed in specification.
35. Local control panel if any required for operation shall be in bidder scope.
36. The solenoid operated valves/Dampers/Gate shall have a limit switch for open/close feedback. Solenoid Valve shall be rated for 24V DC only.
37. All field instruments enclosure shall be IP65 local panel/cabinet enclosure shall be IP 55, unless otherwise specified.
38. Diaphragm seal shall be provided with Instruments having contact with corrosive media.
39. Redundancy of sensors shall be provided by bidder
 - (i) Triple redundancy for all analog and binary inputs required for protection of system/drives.
 - (ii) For all other control functions dual redundancy of the sensors shall be provided by the bidder.
40. Double root valve shall be provided for all pressure tapings where the pressure exceeds 40kg/cm².
41. Number of pairs to be selected for Screen /Control cable
 - a) F-Type: 2P/4P/8P/12P (Size: 0.5sqmm²)
 - b) G-Type: 2P/4P/8P/12P (Size: 0.5sqmm²)
 - c) Core Cable: 3CX2.5sqmm²/ 5CX2.5sqmm²/ 12CX1.5sqmm².
42. Contractor's shall provide Control scheme of HG Plant
43. Bidder shall provide PLC System training for Hardware and Software to customer for 2 persons for week. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope.
44. Instrument installation shall be as per the attached "Standard Hook-up diagram of instrument."
45. In addition to requirements specified here, all C&I systems/ sub-systems/ equipment/ devices shall also meet other requirements stipulated under other Sub-sections/ parts/ sections of specification.
46. In case of any conflict and repetition of clauses in the specification, BHEL discretion will prevail.
47. Measuring instruments (primary & secondary) and analysers offered for this package shall have at least one year's satisfactory operation in one power station having unit rating of 200 MW or above. Provenness certificate shall be provided as per the attached format.



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48. The bidder/its sub-vendor should have designed and supplied at least one (1) number hydrogen generation plant of the type specified, comprising of electrolyser(s) and gas compressor(s) to generate Hydrogen at 5 NM³/hr (minimum) of 99.7% purity (minimum) at the main electrolyser outlet which should have been in successful operation for at least one (1) year. Bidder/its Sub-vendor shall offer only the type of hydrogen generation plant for which he is qualified.
49. For hazardous area, explosion proof enclosure for all the instruments, analyzers, equipment as described in NEC article 500 to be provided. Hazardous area fittings and conduits sealing shall conform with NEC requirements for the area classification.
50. Two out of three measurements philosophy shall be adopted for the control of all critical closed and open loop variables for reliability of operation. The control system shall select the median value for the normal control purpose.
51. In case of deviation of one transmitter output from the other two, the same shall be automatically isolated and average output of the remaining transmitters shall be fed to the control and measurement system and the control loop in this case shall be maintained on auto, with an alarm on the operator's monitor as well as maintenance engineer's monitor. In case of failure of the two remaining transmitters in circuit, deviation of one transmitter output is more than the pre-set limit compared to the other transmitter, there shall be automatic bump less transfer and changeovers shall have suitable alarms.
52. For all other control parameters the number of sensors / transmitters shall be two. One out of two selection logic and selection of average value of the two signals shall be followed.
53. Control and battery room is to be designed by Vendor and details of the same shall be finalized during detail engineering.



TITLE :

3X800MW PATRATU TPP PHASE-1

SPECIFICATION NO. PE-TS-434-168-A001

SECTION : II

**TECHNICAL SPECIFICATION FOR HYDROGEN
GENERATION PLANT**

SUB-SECTION:

REV. NO. 00

DATE :

SECTION – II

GENERAL TECHNICAL REQUIREMENT



TITLE :
3X800MW PATRATU TPP PHASE-1

**TECHNICAL SPECIFICATION FOR HYDROGEN
GENERATION PLANT**

SPECIFICATION NO. PE-TS-434-168-A001

SECTION : I

SUB-SECTION: IIA

REV. NO. 00

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SECTION – IIA

GENERAL TECHNICAL REQUIREMENT (MECHANICAL)



TITLE :
3X800MW PATRATU TPP PHASE-1

SPECIFICATION NO. PE-TS-434-168-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR HYDROGEN
GENERATION PLANT**

SUB-SECTION: IIA

REV. NO. 00

DATE :

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	HYDROGEN GENERATION PLANT	
1.00.00	CONSTRUCTION DETAILS OF EQUIPMENT	
1.01.00	Electrolyser (Generator)	
1.01.01	Electrolyser shall be Sealed Uni-Polar type with alkaline electrolyte or Bi-Polar type with alkaline or solid polymer electrolyte.	
1.01.02	The Cells in electrolyser shall be of corrosion resistant material. Membrane of diaphragm should be non-asbestos. Further for Unipolar design, there shall be provision to isolate any one of the Cells in electrolyser.	
1.01.03	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.	
1.01.04	Proper sealing shall be provided by the Bidder while crossing the wall to avoid any gas leakage to Rectifier Room.	
1.01.05	Each electrolyser shall be fitted with the following instrumentation. (1.) In unipolar design, one explosion proof temperature switch in each cell for electrolyser temperature high alarm on the control panel. However, in case of bipolar design, one explosion proof temperature switch in each generator module for electrolyser temperature high alarm on the control panel. (2.) 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. (3.) One temperature gauge for local indication for electrolyte temperature.	
1.02.00	Rectifier (if applicable) Two numbers, of rectifier (one for each electrolyser) to cater to the load of each of the electrolysers shall be provided. The rectifier equipment shall be complete in all respects with air-cooled rectifier transformer, thyristor converter, electronic control and annunciation, fillers choke, etc. skid mounted for ease of installation.	
1.03.00	Gas washing Tanks (for Uni-Polar Design)	
1.03.01	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. shall be provided.	
1.04.00	Demineralised water tank	
1.04.01	One number tank of Capacity adequate for 5 days normal requirement of hydrogen gas generation on continuous basis at rated capacity of total hydrogen generation plant shall be provided. Further, the tank is to be sized considering 12 hours operation per day.	
1.04.02	DM water tank shall be fitted with removable drain connections, level transmitters, level indicators etc.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.05.00	Caustic solution mixing tank (if applicable)			
	(i)	Capacity	Suitable to fill one electrolyzers	
	(ii)	Material	High Density PVC/HDPE/SS	
	(iii)	Accessories	Removable cover, 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.	
1.06.00	Hydrogen gas Holders (for unipolar design)			
	(i)	Number	Two (2) numbers (one for filling, one for supply to compressor)	
	(ii)	Capacity of each gas holder	As given in Scope Section part-A of this technical specification.	
	(iii)	Material	IS-2062/2002 or equivalent	
	(iv)	To be designed for outdoor duty		
	(v)	To be provided with two (2) Seal pots for each gas holders		
	(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.		
	(vii)	Venting of hydrogen shall be through flame arrestor.		
1.07.00	De-oxy unit (if applicable)			
	(i)	Numbers	Two(2) (One for each stream and capable to remove oxygen as impurity)	
	(ii)	Accessories	Gas cooler, filter, necessary instruments etc.	
1.08.00	Hydrogen compressors and drives			
	(i)	Number	3x50% as specified in the scope (two working & one standby)	
	(ii)	Capacity of each compressor	125% of each stream	
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	(iii)	Design delivery Pressure	150 kg/cm ² (g)	
	(iv)	Type	Preferably Oil free, Piston type of proven design or Diaphragm type with triple diaphragm detection system.	
	(v)	Drive cage	As specified in relevant sub-sections (Electrical) of Technical Specifications.	
	(vi)	Activated carbon filters	2 x100% and required in case of oil lubricated compressor	
	(viii)	All metal to metal joints shall be provided with "O" rings of suitable grade material.		
	(ix)	Compressor shall be as per reputed manufacturer's standard design. The compressor shall include features like built-in relief valves, pressure gauges after every compression stages, pressure switches for low suction and high discharge pressure, diaphragm leak detection, mechanical lubricator, built-in automatic unloader devices (if required by compressor manufacturer), water cooled inter coolers after every compression stage, pressure switch in coolant line, sight flow indicators in coolant line, v-belt drive with pulleys.		
1.09.00	Drying system for Hydrogen gas			
1.09.01	Twin tower Moisture separating columns of Regenerative design alongwith instruments shall be provided.			
1.09.02	Valves arrangement to suit operation of one Column & another under regeneration. The operation shall be automatic based on PLC/ microprocessor command.			
1.10.00	Pressure regulating valve			
1.10.01	Self actuating type back pressure regulating valve to maintain 150 kg/cm ² (g) pressure on the compressor discharge shall be provided.			
1.11.00	Cylinder Manifold			
1.11.01	Two (2) numbers cylinder manifold having four (4) filling point for minimum four cylinders each shall be provided.			
1.12.00	Flushing System			
1.12.01	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.			
1.13.00	Hydrogen leak detection system			
1.13.01	Hydrogen leak detection and interlock system shall be provided in generator/ compressor rooms and hydrogen filling area for alarm and trip of Hydrogen generation plant.			
1.14.00	Piping			
1.14.01	All Pipe to conform to ASA pressure piping code, and seam less type.			
1.14.02	All high pressure joints shall of ferrule/ welded construction.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
1.14.03	All vents to be fitted with flame arrestor.		
2.00.00	Air-Conditioning and Ventilation System		
2.01.00	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.		
2.02.00	The air quantity of ventilation system shall be estimated based on equipment and solar heat gain and the temperature rise inside the building shall be restricted to maximum 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.		
2.03.00	Bidder to provide louvers for fresh air supply as per building layout.		
2.04.00	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.		
2.05.00	Suitable air-conditioning equipment (2x100%) shall be provided for control room of hydrogen generation plant.		
3.00.00	CONTROL AND INSTRUMENTATION		
3.01.00	Refer relevant chapter of Control & Instrumentation.		
4.00.00	PAINTING		
4.01.00	All the Piping, Valves and Equipments of this system shall be protected against external corrosion by providing suitable painting.		
4.02.00	The surfaces of stainless steel, Gunmetal, brass, bronze and non-metallic components shall not be applied with any painting.		
4.03.00	The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, etc. as per agreed procedure.		
4.04.00	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 with Titanium di-oxide with DFT of 100 microns shall be applied. Thereafter, top coat consisting of one coat of epoxy paint suitably pigmented of approved shade with glossy finish and DFT of 75 microns shall be applied. Additionally, finishing coat of polyurethane of minimum DFT 25 microns shall be provided over the top coat.		
4.05.00	Painting of imported items shall however be as per manufacturer's standard practice.		
4.06.00	Corrosion resistant Painting shall be applied considering coastal area.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS
3.04.01 3.04.02 3.04.03 3.05.00 3.05.01 3.05.02	v) Overall fouling factor (minimum) (f) : 0.8×10^{-4} Hr M² deg C/Kcal vi) Overall Heat transfer coefficient[U(o)] : As per manufacturer's design vii) Dirty Heat transfer Coefficient [U(d)] : $[1 / (1/U(o) + 1/f)]$ viii) Heat Transfer Area (Sqm) : $\frac{\text{Total Heat Load (In Kcal/hr)}}{U(d) \times \text{LMTD}}$ Heat transfer area of PHE shall be selected such that each Sq.M of heat transfer plate shall transfer not more than 6500 Kcal/hr. The flow in compressed air piping shall be designed for the design capacity of each compressor and the flow in header and ring mains to be designed for the total capacity of working compressors. The maximum velocity to be considered in compressed air and cooling water piping shall be as mentioned elsewhere in Subsection titled "Low Pressure Piping" in Part-B of this Technical Specification . All hot vessels/pipelines/ valves shall be insulated to restrict the outside temperature within 60 deg.C or less with mineral wool (or equivalent), GI wire netting and aluminum cladding/cover. HYDROGEN GENERATION PLANT GENERAL PLANT DESIGN CRITERIA - To be designed for continuous, as well for as two shift or one shift operation. - The scheme shall be based on manufacturer's standard for the type of Hydrogen generation plant offered by the contractor with all safety measures as per industry practices. - Total Plant Capacity to be sized as follows : - Leakage rate per generator = "A" NM³/day - Requirement of one generator filling = "B" NM³. - Number of TG Units = C - Hydrogen generation plant Capacity = $[C \times 1.5 \times A + B/30] / 12$ NM³/hr - However total plant capacity shall not be less than 12 NM³/hr with two streams of 50% Capacity each of minimum 6 NM³/hr. - Hydrogen purity to be maintained at gas manifolds 99.9%. - Moisture content in hydrogen: - 0.05 gm/m³ (max.) - The Complete Hydrogen generation plant system, equipment, 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. GENERAL OPERATIONAL CRITERIA/PHILOSOPHY - To be designed for Continuous duty as well as shift basis operation.
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.: CS-9585-001-2 SUB SECTION-A-02 EQUIPMENT SIZING CRITERIA PAGE 57 OF 92

CLAUSE NO.	TECHNICAL REQUIREMENTS
	2. To be designed for parallel operation of both streams. 3. Control system shall be provided as specified in relevant Control & Instrumentation sub-section of technical specification. 4. Electrolyser a) Flexibility to operate electrolyser in part load based on demand. b) Safety devices are to be provided on each Hydrogen Generator Skid to release gas pressure in case it goes above the limits. c) The electrolyser circulation circuit should have temperature protection on high electrolyser temperature. d) In case of high electrolyser temp, some means shall be provided to control the electrolyser temp as per standard and proven practice of bidder. e) One off-line specific gravity measuring instrument for electrolyte. 5. Hydrogen Compressors a) To provide alarm & tripping of compressor based on suction conditions / discharge condition / lube oil conditions, etc. Hydrogen Compressor skid shall include discharge pressure switch to stop compressor at set pressure. b) 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. 6. Cylinder Manifold a) To provide accessories such as Isolating valves, safety valves, local & remote pressure measurement (to shut-off compressors beyond set pressure). Trace oxygen analyser and moisture analyser (dew point analyser) shall be installed up stream of cylinder manifold. b) 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. c) Set pressure across dryer to be maintained with the help of pressure regulation valve. 3.06.00 Fire Detection and Protection System 3.06.01 General Design Criteria i) The fire protection system shall consist of fire water storage tanks, fire water pumping system, fire water hydrant and spray system serving the whole station including Employer's plant/ facilities/ buildings. ii) All major equipments / system components in the entire fire protection & detection system shall have the approval from one of the following: a) Underwriters Laboratories of USA b) LPCB –UK c) VDS d) BIS (for the approval of pumps and valves) e) FM - USA
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.: CS-9585-001-2
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CLAUSE NO.	SCOPE OF SUPPLY AND SERVICES 		
	also provide all material, equipment and services which may not be specifically stated in the specifications but are required for completeness of the equipment/systems furnished by the Contractor and for meeting the intent and requirements of these specifications. j) Details related to control system of Ventilation system are indicated in Sub-section IIC, Control & Instrumentation, Scope of Supply & services, Part-A of Technical Specifications.		
5.00.00	HYDROGEN GENERATION PLANT		
5.01.00	One (1) number Uni-Polar/ Bi-Polar type Hydrogen Generation Plant of minimum capacity 12 Nm ³ /hr consisting of the following as per technical specification as elaborated in Part-B of technical specification:		
5.02.00	Two streams of electrolyzers working in parallel (each of 50% capacity). Each stream should consist of air cooled transformer rectifier (power supply) skid and a hydrogen generator skid with integral hydrogen purification system and all types of pumps [Two (2) nos. electrolyte pumps to circulate electrolyte through electrolyzers of each stream (if applicable) and one (1) no. DM pump to maintain DM Level for each stream (if applicable)], instruments and controls required for safe operation.		
5.03.00	Three (3) numbers (2 working + 1standby) of hydrogen gas compressors and drives (each of minimum capacity 1.25 times the capacity of each hydrogen generator stream).		
5.04.00	One number DM water make-up tank of capacity adequate for minimum 5 days of 12 hrs per day operation. One number mixing tank of adequate capacity (if applicable), gas washing system and two gas holders each of capacity equal to capacity of each stream of hydrogen generation plant (if applicable).		
5.05.00	Gas coolers, traps/moisture separator, De-Oxy Units/Tanks to remove oxygen, Back Pressure Regulators in Hydrogen Gas Generators for pressure control.		
5.06.00	Two (2) nos. four (4) point filling manifold, piping, fittings and valves and safety devices, pressure gauges etc, suitable for filling Hydrogen cylinders at 150 kg/cm ² (g).		
5.07.00	Adequate numbers of Nitrogen cylinders and accessories for purging the system two times simultaneously.		
5.08.00	All necessary piping, supports, valves, fittings required for hydrogen stream, cooling water, DM water, air, drains and vents, etc.		
5.09.00	Two (2) nos. On-line trace Oxygen analyzers / H ₂ purity analyser to measure traces of Oxygen or purity of hydrogen gas.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE -I (3X800 MW)		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC.NO.CS-9585-001-2	SUB-SECTION-IIA-11 PLANT UTILITY PAGE 15 OF 16

CLAUSE NO.	SCOPE OF SUPPLY AND SERVICES	एन टी पी सी NTPC	
5.10.00	One (1) no. moisture analyzer for Hydrogen.		
5.11.00	One (1) off-line specific gravity measuring instrument for electrolyte		
5.12.00	One (1) no. on line thermal conductivity analyser.		
5.13.00	Hydrogen detectors for the plant building to cover entire hazardous area.		
5.14.00	Ventilation system for Hydrogen plant building.		
5.15.00	Air-conditioning system for control room located in Hydrogen plant building.		
5.16.00	Supply of all consumables (including electrolyte) required for the erection and Commissioning of the plant.		
5.17.00	The contractor shall be fully responsible and meet any additional requirement if any, for obtaining the necessary licenses / approval / sanctions, etc (including the licenses from the concerned Central Government / State Government / Local Authorities as may be required under any act and / or by law.		
5.18.00	Complete electrical including MCC, illumination, Earthing & lightning protections, control systems with panels, cables and cabling etc.,		
5.19.00	Supply of Mandatory spares as specified.		
5.20.00	Any additional items required to make the system complete.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE –I (3X800 MW)		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC.NO.CS-9585-001-2	SUB-SECTION-IIA-11 PLANT UTILITY
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	<u>LOW PRESSURE PIPING</u>			
1.00.00	EQUIPMENT SIZING CRITERIA			
1.01.00	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.			
1.02.00	For all Low Pressure piping systems covered under this specification, sizing and system design shall be to the requirements of relevant codes and standard indicated. In addition to this, requirements of any statutory code as applicable shall also be taken into consideration.			
1.03.00	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) Ductile Iron.	140		
	(iii) Rubber lined steel pipe	120		
	(iv) Stainless steel pipe	100		
	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.			
	(b) Compressed Air Application			
	Compressed air	15.0 m/sec.(under Average Pressure & Temp. conditions)		
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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 (except stainless steel piping).						
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.						
	SYSTEM	TYPES OF VALVES					
		Butterfly	Gate	Globe	Check	Ball	Plug
	Water	x	x	x	x	x	
	Air/ H2		x	x	x	x	
	Drains & vents		x	x	x		
	Fuel oil (if any)		x	x	x	x	x
1.14.0	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.						
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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.			
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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, etc.) ii) Equipment cooling water including Both primary & secondary circuit (DMCW pH-corrected & ACW drain water)</td><td>IS-2062 Gr.-E-250B/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</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><tr><td>5.</td><td>Effluents from Neutralization pit</td><td>MSRL</td></tr></table>				SI No	Type of Fluid	Material	1.	i) Ordinary Water (Raw Water, Clarified Water, etc.) ii) Equipment cooling water including Both primary & secondary circuit (DMCW pH-corrected & ACW drain water)	IS-2062 Gr.-E-250B/ASTM A-36/ASTM A-53 type 'E'Gr.B/IS-3589 Gr. 410 /IS-1239 Heavy.	2.	i) Demineralised water, ii)Alkaline solution	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	5.	Effluents from Neutralization pit	MSRL
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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.E-250B/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.E-250B 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	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. 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.		
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	Field routed pipes:		
2.04.01	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.		
2.05.00	Slope/Drains and Vents		
2.05.01	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		
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	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.			
2.05.02	Air piping shall be sloped so that any part of the system can be drained through the shut-off drain valve or drain plugs.			
2.06.00	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.			
2.06.01	Screwed Joints (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. (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 field joined by welding for protection of Galvanising Zinc layer. 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 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. (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. (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. (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			
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	galvanic protection has been impaired due to welding of pipe-to-pipe joint. Thus the last erection joint shall be flanged joint.			
2.06.02	Welded Joints (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.			
2.06.03	Flanged Joints (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. (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. (c) Drilling on flanges of flanged valves must correspond to the drilling of flanges on the piping system on which the valves are installed.			
2.07.00	Bends/elbows/mitre bends/ Tees/ Reducers & other fittings			
2.07.01	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). 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.			
2.07.02	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.			
2.07.03	For pipes, above 1200 NB, reducer and tees shall be to dimensional standard of AWWA-C-208.			
2.07.04	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.			
2.07.07	In no case, the thickness of fittings shall be less than the thickness of parent pipe, irrespective of material of construction.			
2.08.00	Flanges			
2.08.01	Flanges shall be slip on type. Welding of flanges in tension is not permitted.			
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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. E-250B. However stainless steel flanges shall be fabricated from SS plates to ASTM-A-240, Gr. 304 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			
	(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 or any international standard.			
2.09.02	Preparation and cleaning of piping			
	(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 or grit blasting, power tool cleaning, etc. Grease or heavy oil shall be removed by washing with a volatile solvent such as gasoline. 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.			
	(b) 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.			
2.09.03	Coating and wrapping/ Anti corrosive Protection Coal tar tape			
	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:			
	(1) Coating primer (coal tar primer)			
	(2) Coating enamel (coal tar enamel)			
	(3) Wrapping materials.			
	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.			
	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.			
	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.			
	Total thickness of completed coating and wrapping shall not be less than 4.0 mm.			
	b. Alternatively, the anti-corrosive protection for buried pipes 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 tar			
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	एनटीपीसी NTPC primer 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.			
2.09.04	Trench bed preparation and back filling 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.			
2.09.05	laying of galvanized steel (GI) pipes 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. 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.			
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 . However for pipe sizes below 100nb the pipes may be cleaned internally by compressed air blowing as an alternative to internal blast cleaning. The brushes shall be of the same or similar material as the metal being cleaned. Cleaning of Galvanized pipes shall be done by air blowing only.			
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	Specification for hangers and supports			
2.11.01	All supports and parts shall conform to the requirement of power piping code ANSI B 31.1 or approved equivalent.			
2.11.02	The maximum spans of the supports of straight length shall not exceed the recommended values indicated in ANSI B 31.1.			
2.11.03	At all sliding surfaces of supports suitable arrangement is to be provided to minimize sliding friction.			
2.12.00	Design/Construction/Material Particulars of Gate/ Globe /Check /Butterfly / Ball / Air release /Float valves / Moisture Traps.			
2.12.01	GENERAL (a) All valves shall have indicators or direction clearly marked on the hand-wheel so that the valves opening/closing can be readily determined.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.:CS-9585-001-2	SUB-SECTION-A-10 (LOW PRESSURE PIPING)	PAGE 9 OF 20

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.12.02	(b) 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. (c) The valves coming in vacuum lines shall be of extended gland type and/or water sealed. (d) The actuator-operated valves shall be designed on the basis of the following: (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. (3) All actuator-operated valves shall be provided with hand operated gearing mechanism also. (4) All actuators operated valves shall open/ close fully within time required by the process. (e) Valves coming under the purview of IBR shall meet IBR requirements. (f) All valves shall be provided with embossed name plate giving details such as tag number, type, size etc. (g) 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. 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 VALVE BODY MATERIAL Valve body material for various services shall be as follows: Valve body material for water application like 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 etc. shall be cast iron for sizes 65NB and above; gun-metal for sizes 50 Nb and below. 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. DM water: SS body and disc along with SS internals. However for butterfly valves, Cast Iron /Ductile Iron/SG iron/carbon steel body and disc with elastomer lining are also acceptable. Condensate: Cast Carbon Steel / Forged Carbon Steel.			
	2.12.03	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.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.12.04	Standards and Codes			
	AWWA-C-504 Rubber seated butterfly valves.			
	BS-5155/EN-593 Cast iron and steel body butterfly valves for general purpose.			
	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.			
2.12.04	End Connections			
2.13.00	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).			
2.13.00	Gate/Globe/Check Valves			
	(a) 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).			
	(b) 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.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(c) All gun metal body valves shall have screwed ends. (d) All flanged end valves/specialties. shall be furnished along with matching counter flanges, fasteners, gaskets etc. as required to complete the joints. (e) Gate/sluice valves shall be used for isolation of flow. 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. Gate valves shall be of the solid/elastic or articulated wedge disc. Gate valves shall be provided with the following accessories in addition to other standard items: (1) Hand wheel (2) Position indicator (for above 50 mm NB valve size) (3) Draining arrangement wherever required. (f) 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. Preferably, the valves shall be of the vertical stem type. Globe valves shall preferably have radiused or spherical seating and discs shall be free to revolve on the spindle. 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. (g) 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. (h) 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); (i) For bore smaller than or equal to 2" the valves must be of the piston type to be installed, in horizontal position. (j) All gate and globe valves shall be provided with back seating arrangement to enable on line changing of gland packing. The valves shall be preferably outside screw & yoke type. (k) 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. (l) 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.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.:CS-9585-001-2	SUB-SECTION-A-10 (LOW PRESSURE PIPING)	PAGE 12 OF 20

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2.13.01	(m)	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.		
	MATERIAL OF CONSTRUCTION (GATE/GLOBE/CHECK VALVE)			
	(a)	The materials shall generally comply with the following:		
	(1)	Cast Steel Valves		
		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	
	(2)	Stainless steel valves		
		Body & Bonnet	SS 304	
		Disc	-do-	
		Trim.	SS 316	
	(3)	Cast iron valves		
		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	
		Stem for gate globe valves	13% chromium steel or Equivalent	
	Back seat	13 % chromium steel / 13% Chrome overlay		
(4)	Gun Metal valves			
	Body and bonnet	IS 318 Gr. 2/ Equivalent Standard		
	Trim.	-do-		
(b)	Cast iron body valves shall have high alloy steel stem and seat.			
(c)	Material for counter flanges shall be the same as for the piping.			
(d)	Forged carbon steel valves are also acceptable in place of Gun metal valves.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.:CS-9585-001-2	SUB-SECTION-A-10 (LOW PRESSURE PIPING)	PAGE 13 OF 20

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.14.00	Air Release Valve (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. (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. (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. (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.			
2.15.00	Butterfly valves			
2.15.01	Design/Construction (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. E-250B) butterfly valves instead of cast iron body valves are also acceptable for size above 300 mm nb diameter. (b) 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 (c) Valves-350Nb and above shall have pressure equalizing bypass valves, wherever system parameters warrant the same. (d) 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. 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.			
2.15.02	Material of Construction (Butterfly Valves) Materials and other design details shall be as indicated below : (a) Cast Iron Butterfly Valves Body & Disc ASTM A48, Gr. 40 with 2% Ni / IS: 210. Gr. FG-260, with 2% Ni / SG iron BSEN 1563, Gr EN GJS-400-15 with 2%Ni and epoxy coated			
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2.15.03	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		
	(b) Stainless Steel Butterfly Valves			
	Body & Disc	SS 304		
	Shaft	SS 316		
	Seat Rings	EPT/BUNA-N/Neoprene		
	(c) Carbon steel Butterfly Valves			
	Body & Disc	ASTM A 216, Gr. WCB		
	Shaft	SS 304		
	Disc & Seat Rings	EPT/BUNA-N/Neoprene		
	(d) Elastomer lined Butterfly Valves			
	Body & Disc	ASTM A48, Gr. 40 / IS: 210. Gr. FG-260 / SG Iron (ductile iron) IS 1865 Gr 400-15 or BSEN 1563, Gr EN GJS-400-15 / ASTM A 216, Gr. WCB with elastomer lining.		
	Shaft	SS 316		
	2.16.00	Proof of Design Test (Type Test) for Butterfly Valves		
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 absence of which actual P.O.D. test shall be conducted by the bidder.				
All valves that are designed and manufactured as per AWWA-C-504 / AWWA-C-516 shall be governed by the relevant clauses of P.O.D test in AWWA-C-504/AWWA-C-516. 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/AWWA-C-516.				
2.16.00	Float operated valves			
	(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.		
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	(b) DESIGN AND CONSTRUCTION FEATURES The following design and construction feature of the valve shall be the minimum acceptable. (c) Valves shall be right-angled or globe pattern. (d) Valves shall be balance piston type with float ball. (e) Leather liner shall not be provided. (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. (g) Valves shall be suitable for flow velocities of 2 to 2.5m/sec. (h) The valves shall have flanged connections.			
2.17.00	Tanks and Accessories			
2.17.01	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.			
2.17.02	DESIGN AND CONSTRUCTION			
	(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) Tank shall be made from mild steel plates to BS 4360/IS-2062 Gr.E-250B (or equivalent) for ordinary wafer application when it is not corrosive in nature. (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. (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. (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. (l) Tanks shall have suitable stairs/ladders on inside and outside of the tanks, manholes/inspection covers as required and also platform suitably located.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.17.03	(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.			
	(o) Tank fabrication drg. and design calculations shall be approved by the Project Manager.			
	Corrosion protection			
	(a) A corrosion allowance, applicable to surface in contact with corrosive media, when required after thorough cleaning by blast cleaning preceded by wire brushing shall be taken into consideration.			
	(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.			
	(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.			

	Sl. No. Description Tech. Particulars			

	1.00 CONDENSATE STORAGE TANKS			
	1.01 Number required one for each unit			
	1.02 Capacity of each tank (Effective) 450 Cu.m (for 800MW units),			
	1.03 Size (Dia & Height)/Plate Thickness 9mx8.2m minimum), Shell & Roof plate Thickness 8mm and Base plate thickness 10mm			
	1.04 Type and pressure class Vertical, cylindrical, atmospheric			
	1.05 Material of construction MS- (IS-2062 Gr.B or equivalent) as per specified code, 8mm thickness (minimum)			
	1.06 Location Outdoor			
	1.07 Overflow, drain, vent and Sample connection(piping &valve) required			
1.08 Level Indicator				
a) Number One for each tank				
b) Type Mechanical float type with dial type indicator (Guide wire, Float and Housing of Stainless steel - 316 Gr. construction)				
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	1.09 Manhole (minimum 500mm size) Two (2)-one on shell and the other on roof 1.10 Special Fittings a) Hydraulic Seal of Overflow/Drain Required b) Additional nozzle Connection number and size to be indicated to successful Bidder c) Nozzle connection for Instrument/spare Three (3) nos. for each tank d) CO2 Absorber for vent (not to be kept on roof of tank, but to be kept on ground level) required e) Outside stair case (spiral) required f) Inside Ladder Required g) Draw off sump required h) Root valve for level Transmitter Root valves for two (2) nos. level transmitter for each tank Required			
2.18.00	RUBBER EXPANSION JOINTS			
2.18.01	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.			
2.18.02	The expansion joints shall be single bellow rubber expansion joints. The arches of the expansion joints shall be filled with soft rubber.			
2.18.03	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.			
2.18.04	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.			
2.18.05	Reinforcement, consisting of solid metal rings embedded in carcass shall be provided.			
2.18.06	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.			
2.18.07	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 'duck' shall be either			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	a superior quality braided cotton or synthetic fibre having maximum flexibility and non-set characteristic.			
2.18.08	The expansion joints shall be adequately reinforced, with solid steel rings, to meet the service conditions under which they are to operate.			
2.18.09	All expansion joints shall be provided with stainless steel retaining rings for DM water application and IS 2062 Gr E-250B 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.			
2.18.10	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. The flanges shall be as per ANSI B 16.5. For higher sizes, not covered under ANSI B 16.5, the same shall be as per AWWA.			
2.18.11	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.			
2.18.12	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.			
2.18.13	Each joint shall have a permanently attached brass or stainless steel metal tag indicating the tag numbers and other salient design features.			
2.18.14	Bidder to note that any metallic part which comes in contact with DM /corrosive water shall be of Stainless Steel material.			
2.19.00	STRAINERS			
2.19.01	Simplex type			
	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:			
	(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	
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2.19.02	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. E-250B 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.			
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TITLE :	SPECIFICATION NO. PE-TS-434-168-A001	
	SECTION : I	
	SUB-SECTION: IIA	
	REV. NO. 00	DATE :

EMPTY HYDROGEN / NITROGEN CYLINDER (46.7 liters water capacity)

1.0 SCOPE

This specification covers the design, manufacture, 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" dia and screw internally to dia 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.

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

6.0 CAPACITY

a.	Water capacity	-	46.7 liters
b.	Volume gas	-	7m ³ (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



TITLE : 3X800MW PATRATU TPP PHASE-1	SPECIFICATION NO. PE-TS-434-168-A001	
	SECTION : I	
	SUB-SECTION: IIA	
	REV. NO. 00	DATE :
TECHNICAL SPECIFICATION FOR HYDROGEN GENERATION PLANT		

10.0 PAINING & MARKING ON CYLINDERS

To be as per IS: 7285

11.0 INFORMATION REQUIRED WITH THE OFFER

Cylinder drawing indicating the following details:

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

12.0 TEST CERTIFICATES

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

13.0 GENERAL

- The offer submitted shall be strictly in line with the requirements specified in this specification.
- All the documents as required in clause 12 and 13 shall be submitted in 5 copies.



TITLE :
3X800MW PATRATU TPP PHASE-1

SPECIFICATION NO. PE-TS-434-168-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR HYDROGEN
GENERATION PLANT**

SUB-SECTION: IIB

REV. NO. 00

DATE :

SECTION – IIB

GENERAL TECHNICAL REQUIREMENT (ELECTRICAL)

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	MOTORS			
1.00.00	GENERAL REQUIREMENTS			
1.01.00	For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment.			
1.02.00	All equipment shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.			
1.03.00	Contractor shall provide fully compatible electrical system, equipment, accessories and services.			
1.04.00	All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.			
1.05.00	Paint shade shall be as per RAL 5012 (Blue) for indoor and outdoor equipment.			
1.06.00	The responsibility of coordination with electrical agencies and obtaining all necessary clearances for contractors equipment and systems shall be under the contractor scope.			
1.07.00	Degree of Protection Degree of protection for various enclosures as per IEC60034-05 shall be as follows:- i) Indoor motors - IP 54 ii) Outdoor motors - IP 55 iii) Cable box-indoor area - IP 54 iv) Cable box-Outdoor area - IP 55			
2.00.00	CODES AND STANDARDS			
	1) Three phase induction motors : IS/IEC:60034 2) Single phase AC motors : IS/IEC:60034 3) Crane duty motors : IS:3177, IS/IEC:60034 4) DC motors/generators : IS/IEC:60034 5) Energy Efficient motors : IS 12615, IEC: 60034-30			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO. : CS-9585-001-2	SUB-SECTION-B-07 MOTORS	PAGE 1 OF 10

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.00.00	TYPE			
3.01.00	AC Motors: a) Squirrel cage induction motor suitable for direct-on-line starting. b) Continuous duty LT motors upto 200 KW Output rating (at 50 deg.C ambient temperature), shall be Premium Efficiency class-IE3, conforming to IS 12615, or IEC:60034-30. c) Crane duty motors shall be squirrel cage Induction motor as per the requirement. d) Motor operating through variable frequency drives shall be suitable for inverter duty. Also these motors shall comply the requirements stipulated in IEC: 60034-18-41 and IEC: 60034-18-42 as applicable.			
3.02.00	DC Motors	Shunt wound		
4.00.00	RATING			
	(a) Continuously rated (S1). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor. (b) Whenever the basis for motor or driven equipment 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 equipment under entire operating range including voltage and frequency variations. (c) For BFP motors, starting MVA shall be restricted to meet requirements indicated in B-0. (d) The starting current for the DC motors shall be restricted to 3 times of the full load current.			
5.00.00	TEMPERATURE RISE			
	Air cooled motors 70 deg. C by resistance method for both thermal class 130(B) & 155(F) insulation.			
	Water cooled 80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method for both thermal class 130(B) & 155(F) insulation.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO. : CS-9585-001-2	SUB-SECTION-B-07 MOTORS	PAGE 2 OF 10

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	41 deg.C over inlet cooling water maximum temperature of 39 deg.C for thermal class 90 (Y) wet wound Boiler circulation pump motor. 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 Starting voltage requirement (a) Up to 85% of rated voltage for ratings below 110 KW (b) Up to 80% of rated voltage for ratings from 110 KW to 200 KW (c) Up to 85% of rated voltage for ratings from 201 KW to 1000 KW (d) Up to 80% of rated voltage for ratings from 1001 KW to 4000 KW (e) Up to 75 % of rated voltage for ratings above 4000KW Except AOP & JOP motors running on D.G emergency supply, starting voltage shall be 80%.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO. : CS-9585-001-2	SUB-SECTION-B-07 MOTORS	PAGE 3 OF 10

CLAUSE NO.	TECHNICAL REQUIREMENTS
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	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). The method of movement of primary and secondary coolant shall be self-circulated by fan or pump directly mounted on the rotor of the main motor as per IEC 60034-6. However VFD driven motors can be offered with forced cooling type with machine mounted fan or pump driven by separate electric motor. Motors and EPB located in hazardous areas shall have flame proof enclosures conforming to IS: 2148 as detailed below (a) Fuel oil area : Group – IIB (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)
7.03.00	Winding and Insulation (a) Type : Non-hygroscopic, oil resistant, flame resistant (b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature. (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 & intertern insulation surge withstand level shall be as per IEC-60034 part-15. However winding insulation for wet wound Boiler circulation pump motor shall be thermal class 90 (Y) or better. (d) 240VAC, 415V AC & 220V DC motors : Thermal Class (B) or better
7.04.00	Motors rated above 1000KW shall have insulated bearings to prevent flow of shaft currents.
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO. : CS-9585-001-2
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CLAUSE NO.	TECHNICAL REQUIREMENTS
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 90 dB(A). Vibration shall be limited within the limits prescribed in IS/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	11 KV motors shall be offered with Separable Insulated Connector (SIC) as per IEEE 386. The offered SIC terminations shall be provided with protective cover and trifurcating sleeves. SIC termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.
7.10.00	3.3 KV motors shall be offered with dust tight phase separated double walled (metallic as well as insulated barrier) Terminal box. Suitable termination kit shall be provided for the offered Terminal box. The offered Terminal Box shall be suitable for fault level of 250 MVA for 0.12 sec. 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.
7.11.00	The spacing between gland plate & center of terminal stud shall be as per Table-I.
7.12.00	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.
7.13.00	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.
7.14.00	For motors rated 2000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.
7.15.00	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.
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO. : CS-9585-001-2
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
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.			
	(a) Below 110KW	:	11.0	
	(b) From 110 KW & upto 200 KW	:	9.0	
	(c) Above 200 KW & upto 1000KW	:	10.0	
	(d) From 1001KW & upto 4000KW	:	9.0	
	(e) Above 4000KW	:	6 to 6.5	
9.00.00	CW motor shall be designed with minimum power factor of 0.8 at design duty point.			
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	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, 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.			
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 employer 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 employer 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	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 should be for			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE–I (3X 800MW		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO. : CS-9585-001-2		SUB-SECTION-B-07 MOTORS
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
10.01.05	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 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 employer either at third party lab or in presence of client/ employer's representative and submit the reports for approval. LIST OF TYPE TESTS TO BE CONDUCTED The following type tests shall be conducted on each type and rating of HT motor (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.			
10.01.06	LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED The following type test reports shall be submitted for each type and rating of HT motor (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. (c) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15 (d) Surge-withstand test on interturn insulation shall be as per clause no. 4.2 of IEC 60034, part-15			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO. : CS-9585-001-2	SUB-SECTION-B-07 MOTORS	PAGE 7 OF 10

CLAUSE NO.	TECHNICAL REQUIREMENTS
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 employer'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. 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.
10.02.02	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 employer either at third party lab or in presence of client/ employer's representative and submit the reports for approval.
10.02.03	LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED The following type test reports shall be submitted for each type and rating of LT motor of above 50 KW only 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. Over speed test.
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CLAUSE NO.	TECHNICAL REQUIREMENTS						
10.03.00 10.04.00	12. Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1						
	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.						
	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.						
	TABLE - I						
	DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS						
	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					
For HT motors the distance between gland plate and the terminal studs shall not be less than 500 mm.							
PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:							
NOTE: Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:							
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Motor MCR in KW UP to 110 KW Above 110 KW and upto 150 KW Above 150 KW	Clearance 10mm 12.5mm 19mm		
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	TITLE	LV MOTORS DATA SHEET-A	SPECIFICATION NO.	
			VOLUME	II B
			SECTION	D
			REV NO. 00	DATE 06/06/2018
			SHEET 1	OF 1

1.0	Design ambient temperature	:	50 °C
2.0	Maximum acceptable kW rating of LV motor	:	≤200KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Degree Of Protection (Indoor/Outdoor)	:	IP54/IP55
5.0	Type of Cooling	:	TEFC/CACA/TETV
6.0	Details of supply system		
	a) Rated voltage (with variation)	:	415V ± 10%
	b) Rated frequency (with variation)	:	50 Hz (Variation: +3% TO –5%)
	c) Combined voltage & freq. variation	:	10%
	d) System fault level at rated voltage	:	50 kA for 1 sec
	e) Short time rating for terminal boxes		
	o 110kW & Above (Breaker controlled)	:	50 kA for 1 sec
	o Below 110kW (SFU+ Contactor controlled)	:	50 KA for 0.20 sec.
	f) LV System grounding	:	Solidly
7.0	Class of insulation	:	Class 'F', with temp rise limited to class B. (Refer clause 3.00.00 of Motors)
8.0	Minimum voltage for starting (As percentage of rated voltage)	:	As per Customer Motor Spec (enclosed)
9.0	Power cables data	:	Shall be given during Detailed engg.
10.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg.
11.0	Space heater supply	:	240 V, 1Φ , 50 Hz
12.0	Rating up to which Single phase motor	:	Acceptable below 0.20 kW
13.0	Tests	:	As per Customer motor spec. (enclosed)
14.0	Energy efficient/ Flame proof motor	:	As per Customer spec. requirement

- Also detail Customer spec. for Motors to be referred as enclosed with spec.
- The requirements mentioned in Customer Motor Spec for Motors shall prevail in case of conflict between the same and the corresponding requirements mentioned in the Section C/ Section D/ Datasheet A

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	TITLE	SPECIFICATION NO.	
		VOLUME	II B
		SECTION	D
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		SHEET	1 OF 2

**MOTOR
DATA SHEET - C**

S. No.	Description		Data to be filled by successful bidder
A.	General		
1	Manufacturer & country of origin		
2	Motor type		
3	Type of starting		
4	Name of the equipment driven by motor & Quantity		
5	Maximum Power requirement of driven equipment		
6	Rated speed of Driven Equipment		
7	Design ambient temperature		
B.	Design and Performance Data		
1	Frame size & type designation		
2	Type of duty		
3	Rated Voltage		
4	Permissible variation for		
5	a	Voltage	
6	b	Frequency	
7	c	Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)		
9	Synchronous speed & Rated slip		
10	Minimum permissible starting voltage		
11	Starting time in sec with mechanism coupled		
12	a) At rated voltage		
13	b) At min starting voltage		
14	Locked rotor current as percentage of FLC (including IS tolerance)		
15	Torque		
	a) Starting		
	b) Maximum		
16	Permissible temp rise at rated output over ambient temp & method		
17	Noise level at 1.0 m (dB		
18	Amplitude of vibration		
19	Efficiency & P.F. at rated voltage & frequency		
	a) At 100% load		
	c) At 75% load		

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	TITLE	SPECIFICATION NO.	
		VOLUME	II B
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MOTOR
DATA SHEET - C

S. No.	Description	Data to be filled by successful bidder
	c) At starting	
C.	Constructional Features	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level (kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
D.	Characteristic curves/ drawings (To be enclosed for motors of rating $\geq 55\text{KW}$)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			



TITLE :

3X800MW PATRATU TPP PHASE-1

SPECIFICATION NO. PE-TS-434-168-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR HYDROGEN
GENERATION PLANT**

SUB-SECTION: IIC

REV. NO. 00

DATE :

SECTION – IIC

GENERAL TECHNICAL REQUIREMENT (CONTROL AND INSTRUMENTATION)



**SPECIFICATION FOR
CONTROL & INSTRUMENTATION FOR AUX
PACKAGES**

SPECIFICATION NO.:

VOLUME

SUB SECTION

REV. NO.

DATE :

SHEET

OF

GENERAL REQUIREMENT

- 1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments for the safe, efficient and reliable operation of auxiliary systems.
- 2.0 The quantity of instruments for auxiliary system shall be as per tender P & ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.
- 3.0 Measuring instruments/equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further all the instruments shall be of proven reliability, accuracy, and acceptable international standards and shall be subject to employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specification, ranges, makes/ numbers as approved by the employer' during detail engineering.
- 4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, switches etc for external connection including spare contacts shall be wired out to suitably located junction boxes.
- 5.0 The customer specification attached as Specific Technical Requirement will supercede the Data sheets, if there is any mismatch.



**C&I SPECIFICATION FOR
HYDROGEN GENERATION PLANT**

SECTION: C
SUB SECTION: C&I

**MEASURING INSTRUMENTS
(PRIMARY & SECONDARY)
&
SPECIFICATION FOR ELECTRONIC
TRANSMITTERS**

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.00.00	MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)			
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 and shall comply with the acceptable international standards and shall be subject to Employer's approval.			
1.02.00	Every panel-mounted instrument requiring power supply shall be provided with 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 transmitters, sensors, switches and gauges 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 in the system under the scope of specification shall be provided on as required basis with in quoted lump sum price. The Contractor shall furnish all Instrumentation / Control equipment & accessories under this specification as per technical specification, ranges, makes & model as approved by the Employer during detailed engineering.			
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	All instruments envisaged for sea water applications, shall be provided with wetted parts made of Monel/ Hastelloy C or any other material (if provenness experience of the proposed material for such applications is established by contractor). For Chlorine application: Instruments shall be provided with wetted parts (e.g. diaphragm seal, etc.) made of Hastelloy C. Also, filled liquid shall be Fluorolube oil/ Inert Hydrocarbon / CTFE etc., for these applications. For applications of FECL3 solution: Instruments shall be provided with wetted parts (e.g. diaphragm seal, etc.) made of Tantalum.			
1.06.00	For coastal areas, all instruments shall be provided with durable epoxy coating for housings and all exposed surfaces of the instruments.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE –I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-04 MEASURING INSTRUMENTS (PRIMARY & SECONDARY)	PAGE 1 OF 46

CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.00.00	SPECIFICATION FOR ELECTRONIC TRANSMITTERS		
2.01.00	SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, DIFF PRESS AND DP BASED FLOW / LEVEL MEASUREMENTS		
	Sl.No.	Features	Essential/Minimum Requirements
	1.	Type of Transmitter	Microprocessor based 2 wire type (loop powered), 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 (minimum)	10:1 for vacuum/very low pressure applications (i.e. pressure <= 200 mmWC) 5:1 for very high pressure application (i.e. pressure >= 200 Kg/cm2) 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
	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 (minimum)
	8.	Housing	Weather proof as per IP-65, metallic housing 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)
	12.	Span and Zero	Continuous, tamper proof, Remote as well as manual adjustability from instrument with zero suppression and elevation facility.
	13.	Accessories	-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition. -2 valve manifold for absolute & Gauge pressure transmitters, 3-valve and 5 valve manifold for DP/Level/Flow applications. The valve manifold shall be non integral type (except Fuel Oil area).
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CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC														
2.02.00	-For hazardous area, explosions proof enclosure as described in NEC article 500 Mounting: 2 inch pipe mounting. 14. Diagnostics & displaySelf-Indicating feature and digital display on transmitter 15. Power supply24V DC ± 10%. 16. Adjustment/calibration/maintenanceFrom hand held HART calibrator/ centralized PC based system (as applicable). Notes - For primary air/ secondary air/flue gas applications, DP type transmitters shall be provided for pressure measurement. - 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 <table><tr><td>Type</td><td>Microprocessor based 2 wire type (loop powered), HART protocol compatible Guided wave radar transmitter.</td></tr><tr><td>Principle</td><td>TDR (Time domain reflectometry)</td></tr><tr><td>Probe Type & Material</td><td>(i) Coaxial probe of SS316/316L. If required, probe shall be suitable for overfill prevention. (ii) Rod probe, cable probe of SS316/SS316L can be used for applications wherever coaxial probe is not suitable.</td></tr><tr><td>Output signal</td><td>4-20 mA DC along with superimposed digital signal (based on HART protocol), suitable for over fill prevention.</td></tr><tr><td>Accuracy</td><td>+/- 0.5% of calibrated span or minimum 5mm.</td></tr><tr><td>Power supply</td><td>24 VDC +/- 10%.</td></tr><tr><td>Housing</td><td>Weather proof as per IP-65, metallic housing with durable corrosion resistance coating.</td></tr></table>				Type	Microprocessor based 2 wire type (loop powered), HART protocol compatible Guided wave radar transmitter.	Principle	TDR (Time domain reflectometry)	Probe Type & Material	(i) Coaxial probe of SS316/316L. If required, probe shall be suitable for overfill prevention. (ii) Rod probe, cable probe of SS316/SS316L can be used for applications wherever coaxial probe is not suitable.	Output signal	4-20 mA DC along with superimposed digital signal (based on HART protocol), suitable for over fill prevention.	Accuracy	+/- 0.5% of calibrated span or minimum 5mm.	Power supply	24 VDC +/- 10%.	Housing
Type	Microprocessor based 2 wire type (loop powered), HART protocol compatible Guided wave radar transmitter.																
Principle	TDR (Time domain reflectometry)																
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Accuracy	+/- 0.5% of calibrated span or minimum 5mm.																
Power supply	24 VDC +/- 10%.																
Housing	Weather proof as per IP-65, metallic housing with durable corrosion resistance coating.																
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE –I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-04 MEASURING INSTRUMENTS (PRIMARY & SECONDARY)	PAGE 3 OF 46													

CLAUSE NO.	TECHNICAL REQUIREMENTS											
2.03.00	Adjustment/ calibration	Using hand held HART calibrator/ centralized PC based system (as applicable).										
	Zero & span adjustment	Continuous, temper proof, remote as well as manual adjustability from instrument. It should be possible to calibrate the instrument without any level in the tank/sump etc.										
	Display	Integral digital display.										
	Load Impedance	500 ohms (minimum).										
	Electromagnetic compatibility	Shall meet EN 61326-1 (1997) and AmdtA1, class A equipment/EN 50081-2 & EN 5008 1-2 & EN 50082-2										
	Mounting	(i) External cage shall be provided where ever side mounting is required. External cage and other mounting accessories to be provided by the contractor. (ii) Where ever top mounting is required, all mounting accessories, stilling well (as required) etc., shall be provided by the contractor. (iii) All weather canopy shall be provided for protection from direct sunlight and direct rain for open locations.										
	Note: Four wire type transmitters can also be provided for applications where 2- wire transmitter has some technical limitations, subject to employer's approval during detailed engineering stage. However, in such cases isolated 4-20 mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 240V AC / 24V DC.											
	Ultrasonic Type level Transmitter											
	<table><tr><th>S.No.</th><th>Features</th><th>Essential/Minimum requirement</th></tr><tr><td>1.</td><td>Type of Transmitter</td><td>Non-contact Microprocessor based 2 wire type (loop powered), HART protocol compatible Ultrasonic transmitter.</td></tr><tr><td>2.</td><td>Output signal</td><td>4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol).</td></tr></table>			S.No.	Features	Essential/Minimum requirement	1.	Type of Transmitter	Non-contact Microprocessor based 2 wire type (loop powered), HART protocol compatible Ultrasonic transmitter.	2.	Output signal	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol).
	S.No.	Features	Essential/Minimum requirement									
1.	Type of Transmitter	Non-contact Microprocessor based 2 wire type (loop powered), HART protocol compatible Ultrasonic transmitter.										
2.	Output signal	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol).										
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE –I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-04 MEASURING INSTRUMENTS (PRIMARY & SECONDARY) PAGE 4 OF 46									

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	3.	Accuracy	+/- 0.5% of calibrated span or minimum 5mm.	
	4.	Power supply	24 V DC +/- 10%.	
	5.	Temperature compensation	To be provided within transducer.	
	6.	Housing	Weather proof as per IP-65, metallic housing with durable corrosion resistance coating.	
	7.	Adjustment/calibration/ maintenance	Using hand held HART calibrator/ centralized PC based system (as applicable).	
	8.	Zero and Span adjustment	Continuous, tamper proof, remote as well as manual adjustability from instrument. It should be possible to calibrate the instrument without any level in the tank/sump etc.	
	9.	Sensor Material	Corrosion resistant material to suit individual application requirement.	
	10.	False signal tolerance	Transmitter shall be capable of ignoring false echoes from internal tank/sumps obstructions such as pipes, heating coils or agitator blades. Also transmitter shall have adjustable damping circuitry.	
	11.	Range	Range of transmitter shall be capable of covering the complete level span of tank taking care of blocking distance, frequency attenuation due to surface, obstructions, vapors etc.	
	12.	Display	Integral digital display	
	13.	Diagnostics	Loss of echo alarm etc.	
	14.	Load Impedance	500 ohms (minimum).	
15.	Electrical Connection	Plug and socket		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	16.	Accessories	- All weather canopy shall be provided for protection from direct sunlight and direct rain for open locations. - All mounting accessories required for erection and commissioning shall be provided. - For hazardous area, explosion proof enclosure as described in NEC article 500	
	Note: 1) Contractor can also provide Radar type transmitter as per above specification in place of ultrasonic transmitter subject to approval by Employer during detailed Engineering. Sonic frequency based transmitters can also be provided under “ultrasonic transmitters” category for fly ash silo level. 2) Four wire type transmitters can also be provided for applications where 2- wire transmitter has some technical limitations, subject to employer’s approval during detailed engineering stage. However, in such cases isolated 4-20 mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 240V AC / 24V DC. 3) For applications where transmitter location is not accessible, the transmitter shall have separate sensor unit and electronic unit for such applications. It shall be possible to mount the electronic unit at accessible location.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
3.00.00	Temperature Elements and accessories			
3.01.00	Thermocouple			
	Sr. No.	Features	Essential/Minimum Requirements	
	1	Type of Thermocouple.	:	16 AWG wire of Chromel-Alumel (Type K) or 24 AWG wire Pt-Rhodium Pt (Type R) depending on operating temperature Range (ungrounded separate junction type).
	2	No. of element	:	Duplex
	3	Housing/Head	:	IP-65/Diecast Aluminium. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection. TE terminal head shall be spring loaded for positive contacts with the thermo well.
	4	Insulation and Sheathing of Thermocouple	:	Swaged type mineral (magnesium oxide) insulation and SS316 sheath.
	5	Calibration and accuracy	:	As per IEC-584/ ANSI-MC-96.1 (special limits of errors/ class1) for T/C.
	6	Accessories	:	Thermo well and associated fittings
	7	Standard	:	IEC-584/ ANSI MC 96.1 for Thermocouple and ASME PTC-19.3 for Thermo-well
3.02.00	Resistance Temperature Detector (RTD)			
	Sr. No.	Features	Essential/Minimum Requirements	
	1	Type of RTD.	:	Four wire, Pt-100 (100 Ohms resistance at zero degree Centigrade).
	2	No. of element	:	Duplex
	3	Housing/Head	:	IP-65/Diecast Aluminium. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE –I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2		SUB-SECTION-IIIC-04 MEASURING INSTRUMENTS (PRIMARY & SECONDARY) PAGE 7 OF 46

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.03.00			provided for external signal cable connection. TE terminal head shall be spring loaded for positive contacts with the thermo well	
	4	Insulation and sheathing of RTD	: Mineral (magnesium oxide) insulation and SS316 sheath,	
	5	Calibration and accuracy	: As per As per IEC-751/ DIN-43760 Class-A for RTD	
	6	Accessories	: Thermo well and associated fittings	
	7	Standard	: IEC-751/ DIN-43760 for RTD and ASME PTC-19.3 for Thermo-well.	
	NOTES :			
	1) The specifications for RTDs of winding/ bearings of motor/pump, can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However the type of RTD shall be Pt100.			
	2) The specifications of temp elements for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.			
	Metal Temperature Thermocouples			
	Measuring Medium	Metal Temperature		
Material of Thermocouple.	Chromel Alumel Type K			
Type of Thermocouple	Duplex with ungrounded separate hot junctions			
Insulation	Mineral Insulation (Magnesium Oxide).			
Thermocouple wire gauge	16 AWG			
Protective sheath	SS 321			
Protective sheath dia	8 mm OD			
Calibration & accuracy	As per IEC-584/ ANSI-MC-96.1 (special limits of error) for T/C			
Mounting accessories	1/2" BSP SS sliding end connector, weld pad, clamps of heat resistant steel SS310. Adjustable gland fitting for connection at the junction box end as per manufacturer's standard.			
Cold end sealing	SS pot seal with colour coded PTFE Insulated flexible tails. Sealing compound- Epoxy resin. Length of PTFE insulated flying leads shall be minimum 750 mm.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC
	Minimum bending radius 30 mm Length of T/C On as required basis considering location of measurement point and the JB/TTJB location. Notes : 1) The specification for thermocouples of bearings metal temp measurements can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However type of thermocouples shall be K-type. 2) For boiler metal temperature applications, considering the location of installations and response time, manufacturer's standard and proven specification for metal temperature measurement can also be accepted subject to employer's approval. The manufacturer shall submit adequate supporting documents for establishing their standard and proven practice.	
3.04.00	Thermo well (for all process temp. elements) (a) Shall be one piece solid bored type of 316 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 required based on the specified boiler design parameters). (d) For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges.	
3.05.00	Not Used	
3.06.0	TEMPERATURE TRANSMITTER (TT) Following types of 2-wire (loop powered) temperature transmitter (directly powered from 4-20mA input cards of DDCMIS/PLC) 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. a. Single Input Head mounted Temperature Transmitter These shall be suitable for mounting in the head of temperature element itself. Temperature transmitter and associated temperature element shall be factory fitted. b. Single Input DIN-rail mounted Temperature Transmitter 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	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC																																				
	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. c. Dual-input Temperature Transmitter With integral Indicator: These shall be suitable for mounting on pipes/ support. Both elements of the duplex thermocouple/ RTD shall be wired to a single transmitter. Integral 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. d. Common requirements for each of the above type of temperature transmitters. <table><tr><td>Output</td><td>:</td><td colspan="2">2-wire (power supply from input card of Control System) with 4-20mA output with superimposed HART protocol signal.</td></tr><tr><td>Input</td><td>:</td><td colspan="2">Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K & R types (input type to be selectable at site through HART terminal).</td></tr><tr><td>Isolation</td><td>:</td><td colspan="2">Min. 500 V AC.</td></tr><tr><td>EMC compatibility</td><td>:</td><td colspan="2">As per EN 61326.</td></tr><tr><td>Operating ambient temperature</td><td>:</td><td colspan="2">0 to 85 deg C (without indicator). 0 to 70 deg C (with indicator).</td></tr><tr><td>Power supply</td><td>:</td><td colspan="2">24V DC +/- 10%.</td></tr><tr><td>Accessories</td><td>:</td><td colspan="2">Mounting arrangements including clamps etc.</td></tr><tr><td>Composite Accuracy (Refer note 2)</td><td>(i)</td><td colspan="2">For head mounted and DIN-rail mounted types: 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</td></tr><tr><td></td><td>(ii)</td><td colspan="2">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</td></tr></table> e. Field bus compatible temperature transmitters 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/enclosures/JBs in non-AC areas.				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	:	24V DC +/- 10%.		Accessories	:	Mounting arrangements including clamps etc.		Composite Accuracy (Refer note 2)	(i)	For head mounted and DIN-rail mounted types: 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			(ii)	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	
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).																																						
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Power supply	:	24V DC +/- 10%.																																						
Accessories	:	Mounting arrangements including clamps etc.																																						
Composite Accuracy (Refer note 2)	(i)	For head mounted and DIN-rail mounted types: 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																																						
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	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. Air conditioned panel shall be provided for remote I/O. Notes (Common for a) to d) above):- 1. In case of failure (open or burn-out) of RTD/thermocouple, temp. Transmitter shall provide low temperature output. 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. All temperature transmitters are to be interchangeable (i.e. can be used for either RTD or thermocouple) and composite accuracy shall be met for each type of input specified in (i) & (ii).			
4.00.00	ELECTRICAL METERING INSTRUMENTS Electrical metering instruments shall be furnished in accordance with the following general specifications. However, the scope shall be governed by the Contract quantity given in appendix-1 to part-A. Application standard for electrical metering instruments shall be as per IS: 1248- 2003 (Revised). The size of each instrument shall be as approved by Employer during detailed engg. All metering instruments shall be flush panel mounting type.			
4.01.00	(a) Frequency meters for Synchronization purposes: Accuracy: ± 1.5% of full scale. (b) Synchroscope: Accuracy class: 0.5 or better. (c) Voltmeters: Accuracy: ± 2.0% of full scale or better.			
4.02.00	Synchronizing Relays Synchronizing check relay with necessary ancillary equipment shall be provided which shall permit breakers to close after checking the requirements of synchronizing of incoming and running supply. The phase angle setting shall not exceed 10 Degree and this angle shall be adjustable and shall take the account the circuit breaker closing period. This relay shall have a response time of less than 200 milliseconds when the two system conditions are met within preset limits and with the timer disconnected. The relay shall have a frequency difference setting not exceeding 0.45% at rated value and at the minimum time setting. The relay shall have a continuously adjustable time setting range of 0.5-3 secs. Additionally, a guard relay shall be provided to prevent the closing attempt by means of synchronizing check relay when control switch is kept in closed position long before the two systems are in synchronism. The Control Voltage shall be 220V DC and PT input Voltage shall be 110 V AC.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC
2.02.00	OTHER TG RELATED SPECIAL MEASURING INSTRUMENT
2.02.01	Analyser Instruments: Common Requirements - Output signals Analog 4-20 mA DC - Binary 2 NO + 2 NC for high alarm - Zero & span Adjustment Available - Ambient temp. 50°C - Indication Digital - Enclosure Type/Material Weather & Dust proof (IP 55) Die cast Aluminium/SS - Type of Electronics Microprocessor based - Digital Signal transmission RS 232 Link & to suit connections protocol to DDCMIS - Calibration Auto & Manual (from Remote) - Error Diagnostic To be provided - Others If analyser provides superimposed HART signal on 4-20 mA DC output, It shall also be connected to PC based station .
2.02.02	Hydrogen Analyser (for Hydrogen Generation Plant) - Output signals: Analog 4-20 mA DC - Zero & span Adjustment Available - Ambient temp. 50°C - Indication Digital - Enclosure Type/Material Weather & Dust proof (IP 55) Die cast Aluminum/SS - Type of Electronics Microprocessor based with self diagnostic facility - Digital Signal transmission protocol RS 232 Link & to suit connections to Control System - Calibration Auto & Manual (from Remote) - Error Diagnostic To be provided - Repeatability ± 1% of calibrated span

CLAUSE NO.	TECHNICAL REQUIREMENTS 
2.02.03	11 Linearity $\pm 2\%$ of calibrated span PH Analyser 1. Type Cell - flow through 2. Accuracy $< \pm 1\%$ 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 7. Type of electronics Microprocessor based with self-diagnostic Facility. 8. Indication Digital 9. Enclosure Weather dust proof (IP55) Die cast aluminum.
2.02.04	Dew point meter (for Hydrogen Generation Plant) 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 $\pm 0.5^\circ$ 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

CLAUSE NO.	TECHNICAL REQUIREMENTS																																																					
2.02.05	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. 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). In case the system is not suitable for Direct online mounting, then all the required sampling system is to be provided by the contractor. All required accessories including cables, sensor holder, desiccant chambers, mounting fixtures etc. are to be supplied by the Contractor within his quoted lumpsum price. Conductivity Monitors <table><tr><td colspan="4">Specific conductance cell</td></tr><tr><td colspan="4">Specific conductance cell shall be provided with suitable electrode material and cell body material taking into account the various factors of actual service conditions, corrosion resistance etc. Cell constant shall be subject to Owner's approval, the cell shall be provided with automatic temperature compensation. The specific conductance cell shall be suitable for use in the plant discharge water.</td></tr><tr><td colspan="4">Conductivity cells are shall be compatible with the conductivity monitors.</td></tr><tr><td colspan="4">The monitor shall have the following design features :</td></tr><tr><td>a)</td><td>Power supply</td><td>:</td><td>240V AC 50, Hz single phase/ 24 V DC</td></tr><tr><td>b)</td><td>Range</td><td>:</td><td>0-1, 0-10, 0-100, 0- 1000, 0- 10,000 micro mho/cm programmable. 0-2500 ppm for dissolved solids.</td></tr><tr><td>c)</td><td>Signal accuracy excluding meter accuracy</td><td>:</td><td>Approximately 1% of full scale</td></tr><tr><td>d)</td><td>Temperature compensation</td><td>:</td><td>Automatic</td></tr><tr><td>e)</td><td>Response time</td><td>:</td><td><=1 sec.</td></tr><tr><td>f)</td><td>Identification</td><td>:</td><td>Phenolic nameplate stating monitor number, sample and conductivity cell number.</td></tr><tr><td>g)</td><td>Output</td><td>:</td><td>4-20 mA DC buffered output capable of driving a minimum load impedance of 500 Ohms.</td></tr><tr><td colspan="4">Analysers, monitors shall be microprocessor based.</td></tr><tr><td colspan="4">The monitor shall be of multi-range type, single range monitor shall not be acceptable.</td></tr></table>	Specific conductance cell				Specific conductance cell shall be provided with suitable electrode material and cell body material taking into account the various factors of actual service conditions, corrosion resistance etc. Cell constant shall be subject to Owner's approval, the cell shall be provided with automatic temperature compensation. The specific conductance cell shall be suitable for use in the plant discharge water.				Conductivity cells are shall be compatible with the conductivity monitors.				The monitor shall have the following design features :				a)	Power supply	:	240V AC 50, Hz single phase/ 24 V DC	b)	Range	:	0-1, 0-10, 0-100, 0- 1000, 0- 10,000 micro mho/cm programmable. 0-2500 ppm for dissolved solids.	c)	Signal accuracy excluding meter accuracy	:	Approximately 1% of full scale	d)	Temperature compensation	:	Automatic	e)	Response time	:	<=1 sec.	f)	Identification	:	Phenolic nameplate stating monitor number, sample and conductivity cell number.	g)	Output	:	4-20 mA DC buffered output capable of driving a minimum load impedance of 500 Ohms.	Analysers, monitors shall be microprocessor based.				The monitor shall be of multi-range type, single range monitor shall not be acceptable.				
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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		

12	Accessories	Blow out disc, SS Thermowell siphon, snubber, pulsation dampener, chemical seal (if required by process) gauge isolation valve	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.

CLAUSE NO.	TECHNICAL REQUIREMENTS		
8.00.00	~~In case it is the proven standard practice of a Contractor to provide vibration monitoring PC with TFT LCD monitor, instead of dedicated monitors with the signal conditioning equipment in control equipment room, the same shall also be acceptable. However, all relevant functional requirements detailed above shall be met and the system shall be subject to Employer's approval.~~		
	E-P Converter		
	E-P converters and associated accessories shall be furnished in accordance with the specifications given below :		
	A. Fail Freeze Type E/P convertes		
	1	Air supply Pressure	: 2 kg/sq. cm.
	2	Input signal	: 4-20mA DC
	3	Output signal	: 0.2 to 1.0 kg/sq. cm
	4	Linearity	: 0.5% of span or better.
	5	Span/Zero Adjustment	: To be provided
	6	Hysteresis	: 0.5% of span or better.
	7	Fail Freeze Feature	: Stay put at last position on failure of 4 –20mA signal.
	8	Allowable drift rate	: Maximum 2% set point/ hour.
	9	Ambient Temperature Effect	: less than 0.02% of span per deg C between -
	10	Mounting	: Surface/Pipe/Bracket Mounting.
	11	Protection class	: IP 65.
12	Connection Port Sizes	: ¼ inch NPT (F)	
13	Electrical Cable Entry	: ½ inch NPT	
14	Output Pressure Gauge	: 1/4 inch NPT connection, 2 inch dial.	
15	Accessories	: All accessories like mounting brackets, fittings etc. required for installation is to be supplied.	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE –I (3X 800MW) TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2 SUB-SECTION-IIIC-04 MEASURING INSTRUMENTS (PRIMARY & SECONDARY) PAGE 23 OF 46			

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	B. Fail Safe type E/P converters			
	1	Air supply Pressure	:	2 kg/sq. cm.
	2	Input signal	:	4-20mA DC
	3	Output signal	:	0.2 to 1.0 kg/sq. cm
	4	Linearity	:	0.5% of span or better.
	5	Span/Zero Adjustment	:	To be provided.
	6	Hysteresis	:	0.5% of span or better.
	7	Fail Safe Feature	:	Output shall drive to minimum on failure of either 4-20mA signal or air supply.
	8	Mounting	:	Surface/Pipe/Bracket Mounting.
	9	Ambient Temperature Effect	:	less than 0.02% of span per deg C between -20 to +60 deg C.
	10	Protection class	:	IP 65.
	11	Connection Port Sizes	:	¼ inch NPT (F)
	12	Electrical Cable Entry	:	½ inch NPT
	13	Output Pressure Gauge	:	1/4 inch NPT connection, 2 inch dial.
	14	Accessories	:	All accessories like mounting brackets, fittings etc. required for installation is to be supplied.
9.00.00	NOT USED			
10.00.00	AMBIENT AIR QUALITY MONITORING STATION (AAQMS)			
10.01.00	General Specifications for AAQMS			
10.01.01	The Analysers / Monitors should be 19" Rack Mounted with the ON / OFF switch and display of all important status signals including Lamps, etc should be preferably on the front panel.			
10.01.02	The system must function properly in the weather and atmospheric conditions mentioned in Sub-Section-IIIC-01, in view of ambient temperature, relative humidity and high dust levels for instruments / equipments housed in an enclosure.			
10.01.03	The system should function without frequent servicing / maintenance. The parts requiring regular service / maintenance must be easily accessible.			
10.01.04	All ambient Gas Analysers and Dust Monitor shall conform to the US EPA reference or equivalent method. A proof of approvals and certificates of the above compliance along with copy of the Test Report (in English) from internationally reputed agencies such as US EPA, TUV / UAB of Germany, Env't Canada, Env't. Japan, EEC etc shall be furnished.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC
	Power Supply 230 VAC or 24VDC operated Process Temperature range 0-200 degree Celsius Others Drain / purging arrangement shall be provided as per standard practice. Viscosity range of Fluid 0-500cst for HFO The offered Coriolis type flow transmitter shall be suitable for intended application. Contractor shall submit flow and sizing calculation for Employer's approval. For each type of Coriolis type flow transmitter general arrangement and assembly drawing and cable wiring diagram shall be submitted for Employer's approval.	
13.00.00	SPECIFICATION FOR FLOW ELEMENTS	
13.01.00	Orifice Plate Features Essential/Minimum Requirements Type Concentric as per ASME PTC-19.5 (Part-II), ISA RP-3.2, 1960 or BS-1042, ISO 5167 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 Same as pipe material Root valve size 1 / 2 inch or 1 inch (as applicable) Impulse pipe of same material up to root valve Required Tappings Flanged weld neck or D & D/2 with 3 pairs of tapping (as applicable). Root valves to be provided in all the tappings. 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) 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.	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE -I (3X 800MW)	TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIIC-04 MEASURING INSTRUMENTS (PRIMARY & SECONDARY) PAGE 35 OF 46

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC		
13.04.00	Root valve size	1 inch			
	Impulse pipe of same material up to root valve	Required			
	Tapping	3 Nos. of tappings for each Venturi as per ISO 5167-4:2003			
	Beta Ratio	0.4 to 0.7			
	Beta Ratio calculation to be Submitted	Yes			
	Assembly drg. and flow Vs DP Curves	Yes			
	Accessories	Root valves, vent and drain hole.			
	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.				
	14.00.00	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		
8.		Accuracy	± 2% of measured value.		
14.00.00	POSITIVE DISPLACEMENT TYPE FLOW TRANSMITTERS				
	The Bidder shall provide positive displacement type flow transmitters for fuel oil flow measurement, suitable for the fuel oil being used for the project, i.e., keeping in view the pressure, temperature and viscosity of the fuel oil. The meter shall be a volumetric meter type consisting of two meshing oval wheels driven by the fluid. Each revolution of the oval wheels shall displace a precisely known volume of the fluid from inlet to outlet. The housing/measuring chamber and oval wheels shall be of 316 SS.				
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE –I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2		SUB-SECTION-IIIC-04 MEASURING INSTRUMENTS (PRIMARY & SECONDARY)	PAGE 37 OF 46

CLAUSE NO.	TECHNICAL REQUIREMENTS			
15.00.00	The measurement accuracy of the transmitter shall be better than +0.2%. The transmitter shall provide suitable 4-20mA dc output signal for control and indication/recording. Converters if necessary shall be provided to generate the 4-20mA signal. A local indicator of fuel oil flow shall also be provided. The instrument shall be calibrated in Tons/hr. Suitable strainer shall be provided before the transmitter for the protection of oval wheel meters against foreign matter contained in the fuel oil. The exact model no. and type of material being used, etc., shall be subject to Employer's approval during detailed engineering without any price repercussion to Employer.			
	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 (5 m minimum, to suit application)	Capacitance types, float type, conductivity type, RF type, Ultrasonic type as per suitability to the 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 maximum operating pr.	-	150% of maximum operating pr.
	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.		
Set point adjustment	Provided over full range.			
Dead band adjustment	Adjustable/ fixed as per requirement of application.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE –I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-04 MEASURING INSTRUMENTS (PRIMARY & SECONDARY)	PAGE 38 OF 46

CLAUSE NO.	TECHNICAL REQUIREMENTS				एन टी पी सी NTPC	
	Enclosure	Weather and dust proof as per IP-55, metallic housing.				
	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)	As per Contractor's Standard practice.				
	Notes :- 1) 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. 2) Pressure/ Diff pressure switches for very low press/ DP measurements can have sensor material other than SS316 in case of any technical limitation and the offered product is standard product of the manufacture for very low pressure applications. 3) Repeatability can be upto +/-1% of full range in case of switches with diaphragm seals or very low pressure/DP range. 4) The specifications of switches for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.					
16.00.00	NOT USED					
17.00.00	SOLENOID VALVES Solenoid valves shall fulfil the following requirements: a. Type 2/3/4 way SS 316/Forged Brass (depending on the application subject to Employer's approval during detailed Engg.) b. Power supply : 24 V DC $\pm$ 10%. c. Plug and socket electrical connection. d. Insulation : Class 'H'					
18.00.00	~~REVERSE ROTATION INDICATOR (RRI)~~ ~~Reverse rotation indicator comprising of proximity sensors, processing electronics with output of 4-20mA (corresponding to speed) interconnecting cables, speed display in rpm,~~					
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE -I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2		~~SUB SECTION-IIIIC-04 MEASURING INSTRUMENTS (PRIMARY & SECONDARY)~~		PAGE 39 OF 46

CLAUSE NO.		TECHNICAL REQUIREMENTS		एनटीपीसी NTPC		
	6.	Type of Electronics	Microprocessor based with self-diagnostic			
	7.	Calibration	Manual			
	8.	Others	All interconnection tubing and cabling between sensor and analyzer / analyzer panel etc to be provided. All chemical reagents required for EQMS analyzers for entire AMC period is to be supplied in phased manner depending on shelf life.			
	9.	Location of the Temp & flow measurement	Effluent Treatment plant outlet (Exact location to be decided by contractor in consultation with site)			
	10.	Location of the Analyser cabinet/enclosure				
	11.	Accessories	All the accessories required for mounting the sensor/analyser are to be provided			
	12.	Digital Signal Transmission	Each analyser shall have a provision for bidirectional soft connectivity over Modbus/RS232/RS485 with employer's central cloud server in addition to 4-20 ma connectivity to DDCMIS.			
	13.	Compliance to standards	CPCB's (Central Pollution control Board) latest regulatory requirement prevailing at the time of execution of the contract.			
	22.02.00	CONDUCTIVITY ANALYSER				
		Type		Continuous flow through type		
Measuring Range		0 – 60000 µS/cm for sea water application 0-5000 µS/cm for other application				
Response Time		<= 5 sec (90% of full scale)				
Temperature Compensation		Automatic				
Power		To be arranged by the contractor				
Accuracy		<= +/- 1 %				
22.03.00		pH ANALYSER				
		Type		Cell flow through sample		
		Measuring Range		0-14 units of pH		
	Temperature Compensation		Automatic			
	Power		To be arranged by the contractor.			
	Accuracy		<= +/- 1 %			
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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.			
1.01.04	Specification for control valves in this Sub-section has to be read in conjunction with other relevant Sub-sections of this specification.			
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 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, HP/LP heater Emergency level control, Emergency Make-up to condenser hotwell, GSC minimum flow, Deaerator Drain to Condenser Hotwell, Condensate spill to condensate reserve tank, condenser normal make-up and valve gland sealing supplying pressure control, CEPS minimum flow control, BFP circulation control valve shall have permissible leakage rate as per leakage Class V. All other control valves shall have leakage rate as per leakage Class-IV as per ANSI / FCI /70.2,2006 or equivalent.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-08 CONTROL VALVES, ACTUATORS & ACCESSORIES	PAGE 1 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS			
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 except for few cases as per contractor's standard and proven practice subject to employer's approval.			
1.02.06	Control valves for steam and water application shall be provided with rangability of 30:1 for all services except for applications wherein control valves are envisaged to be operated in lower range like Reheater spray and superheater spray system wherein control valve with rangability of 50:1 shall be provided			
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 design fluid temperature below 275 Deg. C Alloy steel ASTM-A217Gr. WC6 for design fluid temperature above 275 Deg. C and upto 400 Deg. C Alloy steel ASTM-A217Gr. WC9 for design fluid temperature above 400 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
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS:9585-001-2		SUB-SECTION-IIIC-08 CONTROL VALVES, ACTUATORS & ACCESSORIES
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	3.	Low flashing/cavitation on service	Alloy steel ASTM-A217 Gr. WC6 17-4 PH SS	
	4.	DM water service	316 SS 316 SS	
	NOTE: (a) Valve body rating shall meet the process pressure and temperature requirement as per ANSI B16.34.			
	(b) Severe flashing / cavitation services includes as a minimum all control valves whose downstream piping is connected to condenser or flash tank.			
	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.			
	Contractor shall ensure that all required measures like proper selection of anti-corrosive/erosive material along with durable epoxy coating with polyurethane finish shall be provided for all the C&I equipment/ devices being supplied in this contract, which are mounted in non-AC areas (prone to sea water environment corrosion / erosion) like measuring instruments, control valves & actuators, JBs, LIEs / LIRs, impulse pipes, sample pipes, fittings, conduits, cable trays and accessories, local control panels, erection hardware items etc. Contractor shall furnish their comprehensive proposal regarding the anti-corrosion/ erosion measures for protection against sea water environment which shall be finalized during detailed engineering subject to Employer's approval.			
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.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS:9585-001-2		SUB-SECTION-IIIC-08 CONTROL VALVES, ACTUATORS & ACCESSORIES
PAGE 3 OF 6				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
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			
	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
	3	Software for Configuration and Diagnostics	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
EPC PACKAGE FOR		TECHNICAL SPECIFICATION		SUB-SECTION-IIIC-08
PATRATU SUPER THERMAL POWER STATION		SECTION-VI		CONTROL VALVES,
EXPANSION PHASE-I (3X 800MW)		BID DOC. NO.: CS:9585-001-2		ACTUATORS & ACCESSORIES
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CLAUSE NO.	 TECHNICAL REQUIREMENTS			
			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.
	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 Part-A: Contract quantities 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
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS:9585-001-2		SUB-SECTION-IIIC-08 CONTROL VALVES, ACTUATORS & ACCESSORIES
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
8.00.00				ingress.
			Valves Mounting Assembly	For Sliding Stem/Rotary/Single acting/Double acting actuators on as required basis
	* Note: 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 HART management system specification are mentioned in HART system (Annexure IIIC-02C to DDCMIS). The positioners shall be monitored from this HART management system .To achieve this, Bidder shall provide the necessary software to achieve the functionalities described above under " Software for Configuration and Diagnostics", and this software shall be loaded in the HART management system.			
	TEST AND EXAMINATION			
	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:			
	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/ FCI 70.2 standard 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	CV Test: Please refer CI No. 1.00.00 & 3.00.00 OF Sub-section- IIIC-10 (Type test requirements), Control Valves.		
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.				
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-08 CONTROL VALVES, ACTUATORS & ACCESSORIES	PAGE 6 OF 6



**C&I SPECIFICATION FOR
HYDROGEN GENERATION PLANT**

SECTION: C
SUB SECTION: C&I

SPECIFICATION OF PLC

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	PLANT AUXILIARY SYSTEM			
1.00.00	CONTROL AND INSTRUMENTATION FOR MAIN PLANT AUXILIARY SYSTEMS			
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	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/ Zener barrier of standard make in case it is a standard and proven practice of the bidder. 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.			
1.03.00	Contractor shall provide control system 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.			
1.04.00	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. For Hydrogen Generation plant, Contractor's standard and proven practice in this regard shall also be taken into consideration.			
1.05.00	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 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.			
1.06.00	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) as per standard and proven practice of the contractor.			
1.07.00	The Control system shall generally operate in air conditioned area and shall be suitable for sustained operation for limited air conditioning failure.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIIC-09 PLANT AUXILIARY SYSTEM	PAGE 1 OF 12

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC
2.00.00	MICROPROCESSOR/ PROGRAMMABLE LOGIC BASED CONTROL SYSTEM		
2.01.00	Microprocessor/PLC PROCESSOR		
	The processor unit shall be capable of executing the following functions:-		
	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	For each unit, PLC based control system shall be provided. PLC system shall consist of two processors (Main processing unit and memories) one for normal operation and one as hot standby. In case of failure of working processor, there shall be an appropriate alarm and simultaneously the hot standby processor shall take over the complete process operation automatically. The transfer from main processor to standby processor shall be totally bump less and shall not cause any plant disturbance whatsoever. In the event of both processors failing, the system shall revert to fail safe mode. It shall be possible to keep any of the processors as master and other as standby. The standby processor shall be updated in line with the changes made in working processor. Wherever multiple functional groups have been specified/ required, the above requirements are applicable for each functional group. For Hydrogen Generation plant, the control system shall be as per Contractor's standard and proven practice. 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. For Hydrogen Generation plant, Contractor's standard and proven practice in this regard shall also be taken into consideration.		
2.03.00	Priority of different commands shall be as follows: 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. For Hydrogen Generation plant, Contractor's standard and proven practice in this regard shall also be taken into consideration.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-09 PLANT AUXILIARY SYSTEM PAGE 2 OF 12

CLAUSE NO.	TECHNICAL REQUIREMENTS				
2.04.00	HUMAN MACHINE INTERFACE SYSTEM (HMIS)				
2.04.01	Graphical Interface Unit (GIU) / Operator work station (OWS) shall perform control, monitoring and operation of all auxiliaries/ drives interacting with PLC based/Microprocessor control system. It shall be possible to use the same as programming station of the PLC/ Control system and the Human Machine Interface System. In case the PC based OWS can not be used as programming station of the PLC/ Control system 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	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.				
2.04.04	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.				
2.04.05	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 level and rights for each level shall be changeable by the programmer (Administrator).				
	For Hydrogen Generation plant, Contractor's standard and proven practice in this regard shall also be taken into consideration.				
2.04.06	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. For Hydrogen Generation plant, Contractor's standard and proven practice in this regard shall also be taken into consideration.				
2.02.07	Graphical Interface Unit shall meet the minimum functional requirements of monitoring, operating & controlling the process and displaying information related to process. GIU shall be provided with TFT active matrix display and keypad for operation. GIU shall be ruggedly designed to withstand hard environments like high temperature, shock and vibration.				
2.05.00	PROGRAMMING FUNCTIONALITIES				
	Programming of the PLC/ Control system 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/ Control system shall use either of the following:- <table><tr><td>-</td><td>Flow-chart or block logic representing the instructions graphically.</td></tr></table>			-	Flow-chart or block logic representing the instructions graphically.
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EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-09 PLANT AUXILIARY SYSTEM	PAGE 3 OF 12	

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	- Ladder diagrams. 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 All programming functionalities shall be password protected to avoid unauthorized modification.		
2.06.00	SOFTWARE REQUIREMENT		
2.06.01	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.		
2.06.02	The Contractor shall provide all software required by the system for meeting the intent and functional/parametric requirements of the specification.		
2.06.03	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.		
2.06.04	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.		
2.06.05	All application software for PLC/ Control 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.		
2.06.06	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.		
3.00.00	INPUT/OUTPUT MODULES		
3.01.00	The PLC/ Control 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 contact inputs etc.) and outputs from the control system (non change-over/ change-over type of contact, 24 VDC output signals for energizing interface relays, 4-20 mA output etc.) are to be provided by the Contractor.		
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.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIIC-09 PLANT AUXILIARY SYSTEM PAGE 4 OF 12

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.04.00	The Input/output system shall facilitate modular expansion in fixed stages. For Hydrogen Generation plant, Contractor's standard and proven practice in this regard shall also be taken into consideration.			
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. For Hydrogen Generation plant, Contractor's standard and proven practice in this regard shall also be taken into consideration.			
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. For Hydrogen Generation plant, Contractor's standard and proven practice in this regard shall also be taken into consideration.			
3.07.00	The Contractor shall provide the following monitoring features: a. Power Supply monitoring b. Contact bounce filtering c. 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. For Hydrogen Generation plant, Contractor's standard and proven practice in this regard shall also be taken into consideration.			
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, auxilliary 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/ Control system.			
3.11.00	All input field interrogation voltage shall be 24V DC.			
3.12.00	Wiring Scheme for inputs to control system shall be as per contractor's standard and proven practice.			
3.13.00	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. For Hydrogen Generation plant, Contractor's standard and proven practice in this regard shall also be taken into consideration.			
3.14.00	Any single sensor/transducer/transmitter failure alarm shall be provided on programmer station screens for all sensors/transducers/transmitters. Contractor shall provide remote Input/Output modules Housed in free-standing cabinets/racks (with suitable redundant datalink 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 400 meters from the Central PLC, fiber optic datalink has to be provided. For Hydrogen Generation plant, Contractor's standard and proven practice in this regard shall also be taken into consideration.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-09 PLANT AUXILIARY SYSTEM	PAGE 5 OF 12

CLAUSE NO.	TECHNICAL REQUIREMENTS														
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 10% modules in each of the system cabinets for mounting electronic modules wired up to corresponding spare terminals in system cabinets.														
4.04.00	Each processor / controller shall have 30% spare functional capacity to implement additional function blocks, over and above implemented logic/ loops.														
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.														
5.00.00	DATA COMMUNICATION SYSTEM (DCS)														
5.01.00	The Data Communication System shall include a redundant Main System Bus with hot back-up. Other applicable bus systems like cubicle bus, local bus, I/O bus etc shall be redundant except for backplane buses which can be non-redundant. For Hydrogen Generation plant, Contractor's standard and proven practice in this regard shall also be taken into consideration.														
	<table><tr><td colspan="2">The DCS shall have the following minimum features :</td></tr><tr><td>a</td><td>Redundant Communication controllers shall be provided to handle the communication between I/O Modules (including remote I/O) and PLC/ Control systems and between PLC/ Control systems and operator work station/HMI device. For Hydrogen Generation plant, Contractor's standard and proven practice in this regard shall also be taken into consideration.</td></tr><tr><td>b</td><td>The design shall be such as to minimize 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.</td></tr><tr><td>c</td><td>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.</td></tr><tr><td>e</td><td>The design and installation of the system bus shall take care of the environmental conditions as applicable.</td></tr><tr><td>f</td><td>Data transmitting speed shall be sufficient to meet the responses of the system in terms of displays, control etc.</td></tr></table>			The DCS shall have the following minimum features :		a	Redundant Communication controllers shall be provided to handle the communication between I/O Modules (including remote I/O) and PLC/ Control systems and between PLC/ Control systems and operator work station/HMI device. For Hydrogen Generation plant, Contractor's standard and proven practice in this regard shall also be taken into consideration.	b	The design shall be such as to minimize 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.
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CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
	g	Passive coaxial cables or fibre optic cables shall be employed.		
	The Contractor shall furnish details regarding the communication system like communication protocol, bus utilization calculations etc.			
5.02.00	The PLC/ Control system shall be provided with necessary hardware and software for dual fiber optic connectivity & interconnection with station wide LAN (for scope of Station LAN refer Part-A) for 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 (for scope of BOP C&I System refer Part-A) Supplier including co-ordination and flow of required information etc. for display of all input points under alarm, connected to PLC/ Control system or generated by PLC/ Control system, on various operating stations on BOP C&I System (for scope of BOP C&I System refer Part-A) 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. For Hydrogen Generation plant, Contractor's standard and proven practice in this regard shall also be taken into consideration.			
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 taking into account the contractors standard and proven practice.			
8.00.00	HISTORICAL STORAGE AND RETRIEVAL SYSTEM (HSRS)			
8.01.00	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.			
8.02.00	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.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
9.00.00	CONTROL & POWER SUPPLY SCHEME			
9.01.00	General Requirements The requirements of Electrical Power Supply system are specified herein on system basis. The Contractor shall be responsible for engineering and furnishing a complete and operational system fully meeting the intent and requirements of this specification including tender drawings. All equipment and accessories required for completeness of this system shall be furnished by the Contractor whether these are specifically mentioned herein or not. All the equipments and sub systems offered shall be from reputed experienced manufacturers. All system cabinets, enclosures, & distribution boards shall be manufactured, assembled, wired and fully tested as a complete assembly as per the requirements of this specification at the manufacturer's works. 24 V DC power supply system shall be provided as below:- (A) 24V DC power supply system for PLC based control system shall comprise of two sets, each set shall consist of 1 x 100% Chargers, 1 x 100% Nickel - Cadmium batteries for one (1) hour duty, 1 X 100% DC distribution board. For specification of power supply system refer Sub Section-IIIC-05, Part-B of Specification. (B) All interconnection hardware including cables to be provided. (C) For Hydrogen Plant, 24V DC supply shall be provided as per Cl. 1.03.00(D), Sub Section-IIIC-05, Part-B of Specification. Uninterrupted Power Supply of required capacity shall be provided by contractor for HMI and other relevant equipment of Hydrogen Generation Plant.			
10.00.00	CONTROL CABINETS / PANELS			
10.01.00	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.			
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			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
10.01.04	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. 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 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: (a.) Exterior:- As per RAL 9002 (End panel sides RAL 5012), to be finalized during detailed engineering. (b.) Interior:- Same as above.			
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 system shall have all alarm functions and related function keys like alarm acknowledge, reset, paging, summaries etc. 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. For Hydrogen Generation plant, Contractor's standard and proven practice in this regard shall also be taken into consideration			
11.05.00	Alarm boxes shall be provided in each display to alert the operator about an alarm when he is viewing some other picture. No of alarm boxes shall be finalised during detailed engineering for each process area & each priority therein. For Hydrogen Generation plant, Contractor's standard and proven practice in this regard shall also be taken into consideration			
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
12.00.00	CONTROL DESK		
12.00.01	Industry standard Control desk shall be provided to keep the TFT monitors at top and computers inside. Control desk shall consist of vertical, horizontal and base supports with their coverings for work surface, keyboard trays, mouse pads, monitor shelf and concealed cable and wire way management, perforated trays with covers in both horizontal and vertical directions. PA system handsets, telephone sets, any PB stations and lamps required shall be mounted on the control desk on mosaic grid structure and same shall be decided during detailed engineering. ASCII Keyboard shall be capable of being pulled out through a tray.		
12.00.02	The cabling / wiring between OWS & CPU'S, power supply cables etc. shall be aesthetically routed and concealed from view.		
12.01.00	FURNITURE		
	Chairs – Industry standard revolving chairs with wheels and with provision for adjustment of height (hydraulically/gas lift) shall be provided for the operators, unit-in-charge & other personnel in control room area. These shall be designed for sitting for long duration such that these are comfortable for the back. 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 Employer during detailed engineering.		
	Tables -- Industry standard tables shall be provided for printers.		
13.00.00	SOFTWARE DOCUMENTATION AND SOFTWARE LISTINGS		
13.01.00	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/ Control 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.		
13.02.00	All The software listings including source code for application software, All special - to-project data files etc. shall be submitted by the Contractor.		
14.00.00	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.		
15.00.00	(A) SPECIFICATIONS OF OWS		
	The minimum requirement for PC based OWS shall be as below:		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-09 PLANT AUXILIARY SYSTEM
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CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC																									
	CPU	Latest generation CPU																										
	Removable bulk storage drive (MOD / DVD / DAT)	6 GB (minimum)																										
	Removable Bulk Storage Media for above	10 nos																										
	Monitor	Minimun24 " Full Flat TFT Resolution 1600 x 1280, refresh rate min 85 Hz.																										
	UPS	1 no. on-line Interactive UPS with 30 mins. battery backup on machine load (for PC & its printer)																										
	Software	a General MS Windows latest version, MS-Office, Microsoft Visual Studio, Adobe Acrobat, anti-virus McAfee or equivalent, etc.																										
		b Application software - to suit project specific requirement																										
	Accessories	Required furniture for mounting of HMI peripherals shall be provided.																										
(B) GRAPHICAL INTERFACE UNIT																												
The minimum requirement of Graphical Interface Unit are as follows:																												
<table><tr><th>SI No.</th><th>Description</th><th></th></tr><tr><td>1.</td><td>Power supply</td><td>24 V DC/</td></tr><tr><td>2.</td><td>Display Type</td><td>10.4" Colour, TFT screens with keypad</td></tr><tr><td>3.</td><td>Humidity & Operating Temperature</td><td>5-95%, 0-50 deg C</td></tr><tr><td>4.</td><td>Protection class</td><td>IP-65 for extremely dust prone area, otherwise IP-55. Enclosure shall be provided to prevent ingress of dust.</td></tr><tr><td>5.</td><td>Keys</td><td>Function keys and numeric keys</td></tr><tr><td>6.</td><td>Interfacing requirements</td><td>Interface with PLC system</td></tr><tr><td>7.</td><td>Functional requirements</td><td>Ability to operate drives locally using function keys Graphics display including alarms and operator guidance messages</td></tr></table>					SI No.	Description		1.	Power supply	24 V DC/	2.	Display Type	10.4" Colour, TFT screens with keypad	3.	Humidity & Operating Temperature	5-95%, 0-50 deg C	4.	Protection class	IP-65 for extremely dust prone area, otherwise IP-55. Enclosure shall be provided to prevent ingress of dust.	5.	Keys	Function keys and numeric keys	6.	Interfacing requirements	Interface with PLC system	7.	Functional requirements	Ability to operate drives locally using function keys Graphics display including alarms and operator guidance messages
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CLAUSE NO.	SCOPE OF SUPPLY AND SERVICES	एनटीपीसी NTPC						
9.00.00	CONTROL AND INSTRUMENTATION FOR MAIN PLANT AUXILIARY SYSTEMS							
9.01.00	BLANK							
9.02.00	BLANK							
9.03.00	For certain auxiliary plants, control system shall be provided as indicated below and in Sub-Section Aux. Plant. Ctrl, Part-B of Technical Specification. <table border="1" data-bbox="391 1562 1365 1787"> <thead> <tr> <th>Sl No</th><th>Auxiliary Plant</th><th>Control System</th></tr> </thead> <tbody> <tr> <td>01</td><td>Hydrogen Generation Plant</td><td>A) Independent Microprocessor/PLC based control system as per manufacturer's standard practice : 1 set</td></tr> </tbody> </table>	Sl No	Auxiliary Plant	Control System	01	Hydrogen Generation Plant	A) Independent Microprocessor/PLC based control system as per manufacturer's standard practice : 1 set	
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CLAUSE NO.	SCOPE OF SUPPLY AND SERVICES			एनटीपीसी NTPC
10.00.00 10.01.00 11.00.00 11.01.00			B) Two nos OWS and one no A4 color laser printer. C) Power supply system including batteries and battery chargers and associated cables etc. D) Dual 2-way Ethernet Connectivity utilizing OPC to Station LAN for information.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS 		
16.00.00 16.01.00	Note: Refer Appendix to Part-A FOR QTY of GIU. PRINTER One number A4 size color laser printer at hydrogen generation plant control room shall be provided as a part of the HMIS system. It shall print out all alarm/trip conditions and event changes in plant status along with date and time of occurrence.		
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13.00.00	ANNUAL MAINTENANCE CONTRACT (AMC)
13.01.00	The Bidder shall provide maintenance services of complete PLC System under a comprehensive Annual Maintenance Contract (AMC) for period of one year after Warranty period and thereafter AMC for only hardware support for next two years .
13.02.00	The AMC shall cover total maintenance of all hardware & software coming under the scope of PLC and shall include free repair/replacement of all cards/ modules/ peripherals/ cables/ components etc., correction of software problems and supply of expendable items. The Bidder shall ensure 99.7% availability of the system with the AMC. For that purpose, contractor may maintain adequate no. of staff at site as per his own assessment if considered necessary to ensure availability.
13.03.00	Further, Bidder may note that during the AMC he will be allowed to use Employer's mandatory spares and has to replenish the same within three months time or before completion of AMC period whichever is earlier. However, if in the opinion of the Bidder, more spares than those included in the mandatory spare list are required to meet the availability requirement, then Bidder shall stock the same.
13.04.00	The Bidder shall prepare detailed list of faults corrected and parts, expendables utilised during AMC period and shall furnish the same to Employer, properly documented at the end of AMC period. Further, during AMC period the details as required by Employer/ Project Manager shall be made available by Bidder's personnel.

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1. SCOPE

This specification covers the Design, Manufacture, Assembly, Inspection and Testing at manufacturer's works, proper packing and delivery to site, erection & commissioning, site acceptance test of the Programmable Logic Controller(PLC) System comprising of PLC Control panel/Remote I/O panel (housing Processors, I/O cards, power supply packs etc.), Engineering Workstations(EWS)/ Operator workstations(OWS), Printers, Annunciation system, cables and all other equipment and accessories required for completeness of the system as mentioned in different sections of this specification.

2. GENERAL

- 2.1. The offered PLC shall be of Industrial Grade and all the hardware/software shall be from Original Equipment manufacturer (OEM).
- 2.2. The PLC shall be capable of 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. PLC shall be capable of performing Boolean logic and modulating functions for control, protection and annunciation of the equipment and systems, providing supervisory information for alarm, various types of displays, status information, trending, historical storage of data etc., performing self-monitoring and diagnostic functions.
- 2.3. The system shall be redundant in processor, power supply (bulk, rack) and communication interfaces unless otherwise specified. Redundancy of I/O modules shall be as specified in the Datasheet-A&B. The control of all drives and equipment shall be effected through the keyboard/mouse / panel mounted push button / control switches as per Data sheets-A&B. The system shall include self-diagnostic features not limited to the following:-
 - Memory Faults, both PROM and EPROM
 - Processor Faults
 - Communication Faults
 - I/O interface or address faults
 - Voltage signal discrepancy on input and output
 - Power supply faults
 - Output loop check
 - Channel level diagnostics such as fault monitoring, contact bounce filtering etc.

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- 2.4. The system shall have facility for connecting to Main Plant's Distributed control system (DCS) using hardware/software interface for two-way transfer of signals.
- 2.5. The mimic shall be displayed on the OWS screen and may also be provided on the control desk/panel (as per Datasheet-A&B).
- 2.6. In case OWS is provided, HMI functions like trends, curves, bar charts, historical storage of data, logs and reports etc. shall be provided in addition to Plant schematics. The necessary catalogue / literature elaborating the features of HMI shall be supplied along with the bid.
- 2.7. It shall be possible to configure OWS as EWS without any additional hardware.
- 2.8. The PLC system shall be sized to meet process/system requirements as per the approved P&IDs and Control write-up.
- 2.9. The PLC system shall be designed to ensure that no single device failure should result in failure of any other device.
- 2.10. Signal multiplication where required shall be done in PLC. Use of relays for multiplication of contacts (for control, monitoring and alarm) is not acceptable. The control/ monitoring components on the control panel/ desk shall be driven through I/O modules.
- 2.11. Bidder shall provide all software on CDs along with required dongles, software licenses. Bidder shall provide software licenses for all software being used in the supplied system. The software licenses shall be in the name of customer/owner. The software/licenses shall be hardware / machine-independent so that same software /licenses is usable. All licenses shall be valid for the continuous service life of the plant. Software modification and up gradation, as applicable till the system is handed over to customer, shall also be in the bidder's scope without any cost implication.

Bidder shall periodically inform the plant owner/customer about the software upgrades/new releases that would be taking place after the system is handed over to customer.
- 2.12. All PCs used as HMIs like OWS/EWS/Storian/SER etc. shall be provided with industry proven antivirus software with perpetual license (free version not acceptable).

3. TECHNICAL REQUIREMENTS

Details of various PLC system components shall be inclusive of but not limited to the following:

3.1. CODES AND STANDARDS

- 3.1.1. The equipment covered under this specification shall meet the requirements of latest edition of all applicable codes and standards like ANSI, NEMA, IEEE, IEC, NEC & IS.
- 3.1.2. PLC shall conform to IEC: 61131
- 3.1.3. The offered PLC shall comply with safety standards as per Data sheet-A&B.

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3.2. CONTROL PANEL

3.2.1. PLC control panel shall be freestanding type with provision for mimic display, push-button stations, control switches, indicating lamps, metering instruments like Indicators, ammeters etc. and facia windows for critical alarms.

3.2.2. 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) and not less than 1.6 mm for others

Gland plate thickness: 3.0mm

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

3.2.3. Each panel shall be identified by name plate of SS316 or three ply lamicoid, with engraved lettering.

3.2.4. Vendor shall indicate earthing details during detailed engineering.

3.2.5. 25 x 6 mm Copper ground bus to be provided for each panel.

3.2.6. 240V AC single phase, thermostatically controlled space heaters shall be provided. Each free standing panel shall have a door switch operated fluorescent lamp and a 240V AC plug point.

3.2.7. Painting treatment shall be as per IS: 6005. Two coats of lead oxide primer shall be followed by powder coating. Paint shade shall be as specified in the "Data sheet-A&B for PLC system". Project specific paint shade, if applicable, shall be followed.

3.2.8. Panel internal wiring shall be as per NEC and NEMA standard.

3.2.9. TB points in terminal block shall be cage clamp type/screw type as per Datasheet-A&B.

3.2.10. The annunciation system shall be facia window type, driven by the PLC. Audible alarm, Acknowledge, Reset and lamp test facility shall be provided as per ISA sequence – S18.1, M.

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3.3. PROCESSORS

- 3.3.1. The microprocessors shall be 32 bit minimum, and Hot redundant.
- 3.3.2. Hot redundancy: PLC shall be provided with two processors (Main processing unit and memories) one for normal operation and one as hot standby. Dedicated redundant link to establish hot redundancy between processors shall be considered. In case of failure of working processor, there shall be an appropriate alarm and simultaneously the hot standby processor shall take over the complete operation automatically. This transfer from main processor to standby processor shall be bump less and shall not cause any disturbance whatsoever. In the event of both processors failing, the system shall revert to fail safe mode. It shall be possible to keep any of the processor as master and other as standby.
- 3.3.3. An authorized forcing facility shall be provided for changing the status of inputs and outputs, timers and flags to facilitate fault finding and other testing requirements.
- 3.3.4. The standby processor shall be updated automatically in line with the changes made in the working processor.
- 3.3.5. In the event of any replacement of the processor, synchronization of the replaced processor shall be automatic upon live insertion.
- 3.3.6. The cycle time for input scanning, execution of logics, overheads and output scan shall not exceed 120 m sec.
- 3.3.7. The processor & memory shall be loaded up to 50% at normal conditions and maximum up to 60% under worst loading conditions.
- 3.3.8. The memories shall be field expandable. Memory capacity shall be sufficient for complete system operation and have a capability for at least 20% expansion in future.
- 3.3.9. Memory shall be non-volatile, preferably EEPROM type. However, in case volatile memory is provided, battery backup shall be provided for a minimum of three months to keep the stored program intact. Battery drain indication shall be provided at least 1 week before the battery gets drained and same shall be annunciated in OWS. The batteries shall be lithium or Ni-Cd type.

3.4. INPUT / OUTPUT Modules

- 3.4.1. Input/output card assignments shall be modular i.e. no single card shall be assigned with more than one drive of a particular sub-system. The maximum number of channels per I/O module shall be as follows unless indicated in the Datasheet-A&B:-
- Analog Input Module(4-20mA): 16
 - Analog Output Module: 16
 - RTD Module: 4
 - Thermocouple module: 8
 - Binary Input Module: 32
 - Binary Output Module: 32

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- Analog Input/output combined: 16
- Binary Input/output combined: 32

- 3.4.2. On line module replacement (hot swappable): All modules cards shall have quick disconnect terminations allowing for card replacement without disconnection of external wiring and without switching off the power supply.
- 3.4.3. Each I/O shall be protected against the reversal of polarity of the power voltage to I/O.
- 3.4.4. 10% spare capacity shall be ensured in each card channel assignment .Overall minimum 20% spare channels shall be provided. Spare channels/cards/slots shall be fully wired up to panel Terminal Block.
- 3.4.5. Output command to MCC/Switchgear shall be through coupling relays, whose mounting location shall be as per Data sheet A & B. The contact rating shall be 5A, 230VAC/0.5A,220VDC . The power rating shall not be less than 6VA. In case coupling relays are located in PLC Panel, the same shall be in PLC bidder's scope of supply.
- 3.4.6. Status feedback from MCC shall be in the form of potential free contact.

3.5. DATA BUS/ I/O BUS

- 3.5.1. The Data bus connecting PLC and HMI work stations shall be TCP/IP on Ethernet.
- 3.5.2. The Data bus and I/O bus communication medium shall be twisted pair shield copper conductor for indoor locations and those areas not subjected to induced signals. Repeaters/signal amplifiers shall not be used. Copper conductor cable used shall be Category-6 or better. The communication medium shall be Fibre optic cable in the event any portion of communication cable run is in outdoor or where distances are beyond 500 meters.

3.6. OPERATOR WORK STATION (OWS)

- 3.6.1. The OWS and Keyboard shall be desktop mounted and shall be used for controlling, monitoring and programming function.
- 3.6.2. Colour monitor/TFT with keyboard and mouse shall be as per Data Sheet-A&B. Monitor shall have graphic display facility.
- 3.6.3. The OWS shall be with Windows based operating system having necessary Engineering/Configuring software.
- 3.6.4 Specification of OWS.



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(a) CPU

1. Processor	32 Bit or better
2. Main Memory	Min. 1 GB and expandable to at least 4 GB
3. Hard drive	Min 40 GB
4. Removable bulk storage	DVD (R/RW)
5. Graphic memory	Min. 16 MB
6. Auto controller	16 bit or better
7. Operating system	Windows 7 or higher
8. Communication ports	2 serial, 1 parallel, 8 Nos. USB, Dual 100 MB Ethernet
9. Expansion slot	3 Nos. or more

(b) Monitor

1. Type	LCD colour monitor (Flat TFT based) Resolution 1600X1280
2. Screen diagonal	Refer Datasheet- A&B
3. Display	XGA or better
4. Degree of Protection	IP-30
5. External controls	Brightness, Contrast, Horizontal/vertical amplification & shift
6. Power supply	240 VAC, 50 Hz, 1 phase
7. Version	Industrial grade

(c) Keyboard & Mouse

1. Type	Flat spill membrane or positive depression type ASCII
2. Life expectancy	50 Million cycles per key
3. Version	Industrial
4. Mouse	Optical

(d) Software (in addition to Application software)	General MS Windows latest version, MS-Office Adobe Acrobat, anti-virus McAfee or equivalent.

3.7. PRINTER

Printers shall be provided as per Data Sheet-A&B.

3.8. COMMUNICATION WITH PLANT DCS/ THIRD PARTY SYSTEM

- 3.8.1. The PLC system shall be provided with hardwired/serial interface for communication with plant DCS. Hardwired outputs from PLC shall be isolated. Necessary isolators shall be part of PLC.
- 3.8.2. Communication to / from DCS where provided shall be engineered to ensure that signal communication time from / to DCS shall not exceed 1 seconds for control.
- 3.8.3. Communication to DCS shall be using OPC (Data access 2.0)/MODBUS on TCP/IP Protocol. Alternatively the serial communication shall be MODBUS RTU on RS 485 network. Please refer Datasheet-A&B.
- 3.8.4. Data transmitted from PLC to DCS shall include all information necessary for the DCS graphic displays to monitor and control the process equipment and PLC. Such data may include pertinent analog and digital status information, interlock, alarms and maintenance conditions. Data transmitted from DCS to the PLC shall include

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necessary signals to provide operator control interface from DCS for the process/ equipment being controlled by PLC.

- 3.8.5. Bidder to include 'Light interface units, converters, Ethernet switch, accessories etc. at PLC end for connectivity to other system. The bidder's terminal point shall be

- (i) LIU in case of Fibre optic connection.
- (ii) Ethernet port (for TCP/IP protocol) or PLC panel TB (for MODBUS on RS-485) in case of copper medium connection.

Fibre optic cable between PLC and other systems shall be single mode only.

- 3.8.6 Bidder shall consider the required hardware/software to interface PLC with Numerical relays using IEC-61850 protocol, as per Datasheet-A&B.

- 3.8.7 Bidder shall consider the required hardware/software to interface PLC with Master clock System (Plant area) for time synchronization, as per Datasheet-A&B.

3.9. POWER SUPPLY Scheme

- 3.9.1. PLC Panel and I/O Cabinets: PLC system shall be powered with 2x100% UPS. For further details, refer UPS specification attached elsewhere. Necessary redundant power pack and transformers shall be provided (in the PLC panel) to derive the power supply for control desk, PLC panel and input / output cabinets etc.

- 3.9.2. Remote I/O panels: Similar power supply arrangement as for PLC panels shall be provided if it is not possible to extend the power cable from UPS of PLC panels.

- 3.9.3. Each OWS and associated HMI peripherals e.g printers, switches etc. shall be provided with a feeder from UPS.

4. DRAWING/DOCUMENT AND DATA TO BE FURNISHED AFTER AWARD OF THE CONTRACT:

4.1. For Approval:

- PLC system configuration drawing along with functional write-up.
- Input/output signal list.
- BOM of PLC
- List of PLC controlled devices
- Control panel/control desk GA drawings.
- Control desk/panel component layout drawing.
- Control panel/control desk Foundation detail.
- Power distribution scheme for PLC system, HMI & peripherals, Remote I/O etc.
- Block logic diagrams/ Ladder diagram mimic.
- Annunciation list.
- PLC control room layout drawing.
- List of soft signal exchange with Plant DCS.
- List of mandatory spares, as applicable.
- Quality plan
- Factory Acceptance Test.
- Data Sheet-C
- Screen shot of graphics/mimics.
- Power supply scheme for PLC system, HMI & peripherals, Remote I/O etc.

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4.2. For Information:

- Cable schedule and cable interconnection drawing(in BHEL approved format)
- Electronic earthing requirements.
- Panel Heat dissipation data
- Product/component catalogues.
- Operation & Maintenance Manual on CDs.
- Softcopy of Final/As-built drawings on CDs.
- Calculation for Processor, Memory & Data bus loading

The above list is the minimum requirements. Additional documents/calculations required shall be finalized during contract stage.

5. DRAWINGS AND DOCUMENTS TO BE SUBMITTED ALONG WITH THE BID

- Proposed PLC system configuration drawing with write-up
- Product catalogues and specifications for PLC as well as HMI application.
- Proposed power supply schemes for PLC system, peripherals, and Remote I/O panels.

6. TESTING AND INSPECTION

- 6.1. The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.
- 6.2. BHEL's standard Quality Plan for PLC 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.
- 6.3. The complete PLC system, including all instrument and devices shall be subjected to standard factory tests (i.e. Type Tests and Routine Tests) as per relevant IS, NEMA, IEEE, IEC.
- 6.4. Factory Acceptance Test-FAT (Functional Tests) shall be performed prior to shipment and Owner/Purchaser shall be notified 15 days before the schedules dates of the test.
- 6.5. The certificates for following type tests, as per IEC Standard, shall be submitted: -
 - Surge protection test as per IEC-225-4
 - Dry heat test as per IEC-68-2-2
 - Damp Heat test as per IEC-68-2-3
 - Vibration Heat test as per IEC-68-2-6
 - Electrostatic discharge test as per IEC-801-2 or equivalent
 - Radio frequency Immunity test as per IEC-801-6 or equivalent
 - Electromagnetic Immunity test as per IEC-801-3 or equivalent

7. SPARES AND CONSUMABLES

7.1. 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.

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7.2. Mandatory Spares

The bidder shall offer along with 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.

7.3. 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 along with unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.

7.4. Special Tools & Tackles

The bidder shall supply all Special Tools & Tackles 'as required' during Start-up and further maintenance of the system, as part of the main equipment supply.

7.5. Spares, Service support

Bidder shall provide availability of spares and service support for minimum 15 years after guarantee period.

8. MARKING AND PACKING

8.1. Marking:

A stainless steel name-plate shall be permanently fixed on each equipment giving its Tag/serial Number and salient technical specification.

8.2. Packing:

All equipment/materials shall be suitably packed and protected for the entire period of dispatch, 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.

8.3. Applicability of sea worthy packing shall be as per Datasheet-A&B.

9. APPLICABLE DATA SHEET FORMS

This document shall be read with the following data sheet forms:

- Data Sheet A & B for PLC system - PE-DC-999-145-I036-1
- Data Sheet C for PLC system - PE-DC-999-145-I036-2

	DATA SHEET FOR PLC SYSTEM		SPECIFICATION NO.:	
			VOLUME II B	
			SECTION D	
			REV. NO. 02	DATE: 20.05.2016
			SHEET 1	OF 2
Data Sheet No.: PES-145-36-DS2-0				
Data Sheet-A&B				
DATA SHEET – A (TO BE FILLED BY PURCHASER)			DATA SHEET – B (TO BE FILLED BY BIDDER)	
GENERAL	PROJECT	PATRATU (2X800 MW)		
	SERVICE	HYDROGEN GENERATION PLANT		
	QUANTITY	☐ UNITISED ☒ COMMON		
	LOCATION	☒ INDOOR ☐ OUTDOOR ☒ AC ☐ NON-AC*		
PLC EQUIPMENT	MAKE / MODEL NO.	BIDDER TO INDICATE		
	PROCESSOR	REDUNDANT WITH HOT STANDBY		
	DATA BUS (HMI)	☐ COPPER WIRE ☒ FIBRE OPTIC		
	DATA BUS (I/O - CPU)	☐ COPPER WIRE ☒ FIBRE OPTIC		
	DATA BUS (REMOTE I/O - CPU)	☐ COPPER WIRE ☒ FIBRE OPTIC		
	FIELD CONTACTS INTERROGATION VOLTAGE	☒ 24 V DC ☐ 48 V DC ☐ 110 V AC ☐ OTHERS		
	LOCATION OF COUPLING RELAYS FOR COMMAND INTERFACE	☒ MCC ☐ PLC PANEL		
	OWS REQUIREMENT	☐ ONE ☒ TWO ☐ _____ ☐ DESKTOP VERSION ☐ SERVER VERSION ☒ WORK STATION VERSION REQUIREMENT OF OWS IN REMOTE LOCATION ☐ YES ☐ NO QUANTITY _____		
	MONITOR TYPE	☐ 19" ☐ 22" ☒ 24" TFT/CRT MONITOR ☒ GIU ☐ OTHERS		
	PRINTER	INKJET ☐ A3__NOS ☐ A4__NOS LASER B/W ☐ A3__NOS ☐ A4__NOS COLOR INKJET ☐ A3__NOS ☐ A4__NOS COLOR LASER ☒ A3_1_NOS ☐ A4__NOS		
PROGRAMMING / CONFIGURATION FACILITY	A) ☐ HAND HELD ☐ LAPTOP B) ENGINEERING SOFTWARE ☐ ONE OWS ☒ ALL OWS ☐ _____			
SAFETY STANDARD	☐ SIL-3 ☐ SIL-2 ☒ National Electric Code (USA), Article 500, Class-I, Division-1 or EN60079-14			
	COMPUTER FURNITURE (INDUSTRIAL GRADE)	APPLICABLE ☒ YES ☐ NO		
ENGINEERING SPARES	SPARE LIST	☐ START UP & COMMISSIONING ☐ MANDATORY SPARE ☒ RECOMMENDED		
	SPARE LIST ATTACHED	☐ YES ☐ NO		
REDUNDANCY IN HARDWARE	CPU	☒ YES ☐ NO		
	POWER SUPPLY CARD	☒ YES ☐ NO		
	COMMUNICATION CARD	☒ YES ☐ NO		
	I/O CARD	☒ YES ☐ NO		
	OTHER ELECTRONICS	_____		

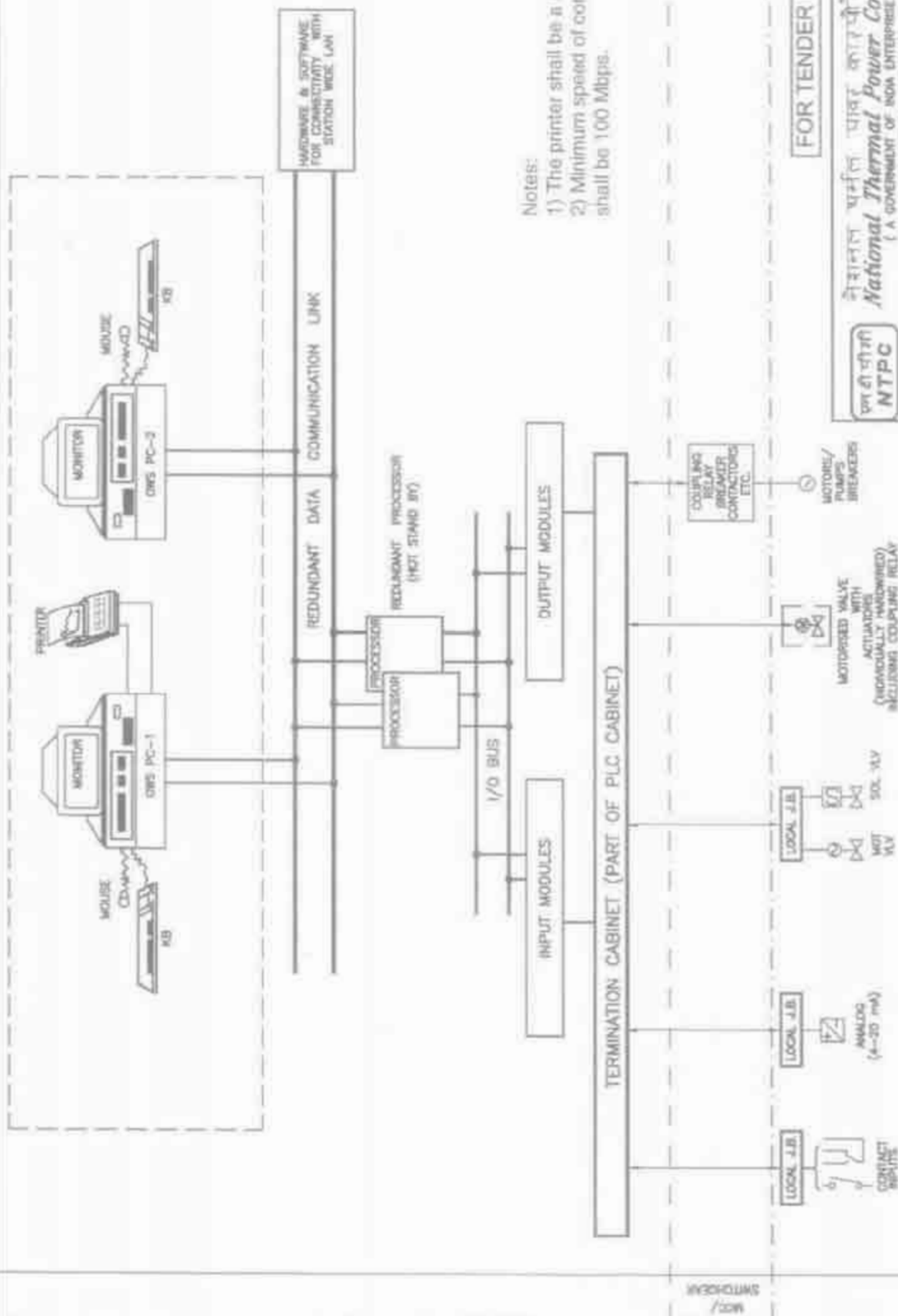
	DATA SHEET FOR PLC SYSTEM		SPECIFICATION NO.:	
			VOLUME II B	
			SECTION D	
			REV. NO. 02	DATE: 20.05.2016
			SHEET 1	OF 2
Data Sheet No.: PES-145-36-DS2-0				
Data Sheet-A&B				
DATA SHEET – A (TO BE FILLED BY PURCHASER)			DATA SHEET – B (TO BE FILLED BY BIDDER)	
No. of CHANNELS PER CARD	ANALOG INPUT	☐ 8 NOs ☒ 16 NOs		
	ANALOG OUTPUT	☐ 8 NOs ☒ 16 NOs		
	BINARY INPUT	☐ 16 NOs ☒ 32 NOs		
	BINARY OUTPUT	☐ 16 NOs ☒ 32 NOs		
	RTD**	4 NOs		
	THERMOCOUPLE**	8 NOs		
	ELECTRONIC CARD ISOLATION	☐ GALVANIC ☒ OPTICAL ☐ OTHER		
TERMINAL BLOCKS (TB)	TYPE	☒ CAGE CLAMP ☐ SCREW		
	ORIENTATION	☒ HORIZONTAL ☐ VERTICAL		
PANEL	QUANTITY	BIDDER TO INDICATE		
	CLASS OF PROTECTION	IP 22		
	REMOTE I/O PANEL	☐ YES ☒ NO AC REQUIREMENT ☒ YES ☐ NO PANEL FITTED AC ☐ YES ☒ NO		
	COLOUR#	Exterior RAL9002 and end panel sides RAL5012		
	PAINTING SCHEDULE	☐ AS PER SECTION D ☒ CUSTOMER SPECIFIC		
	BACK-UP DESK	☐ YES ☒ NO		
	MIMIC ON PANEL	☐ YES ☐ NO IF YES, THEN ☐ PANEL MOUNTED GUI ☐ ACRYLIC		To be decided during detailed engineering
	CONTROL HARDWARE	☐ PB ☐ INDICATORS ☐ FACIAS _____ Nos. ☐ OTHERS		To be decided during detailed engineering
	CONFORMAL COATING	☐ YES ☐ NO		To be decided during detailed engineering
	COMMUNICATION WITH OTHER SYSTEM	HARDWIRED	☐ YES ☒ NO	
PURPOSE		☐ CONTROL ☒ MONITORING		
MEDIUM		☐ UTP ☒ FIBRE OPTIC ☐ OTHERS		
TIME SYNCHRONIZATION SIGNAL FORMAT		☐ RS-485 ☒ IIRIG-B ☐ NTP		
PROTOCOL FOR SOFTLINK		☐ MODBUS ☒ OPC IF MODBUS THEN ☐ RS-485 ☐ ETHERNET		
NUMERICAL RELAYS USING IEC-61850 PROTOCOL		APPLICABLE ☒ YES ☐ NO		
PACKING	SEA WORTHY PACKING	APPLICABLE ☐ YES ☒ NO		
CUSTOMER TRAINING	TRAINING	☒ REQUIRED ☐ NOT REQUIRED		
	NO OF MAN DAYS	---7 days . MAN DAYS		
	LOCATION	☐ VENDOR'S WORK ☒ PROJECT SITE ☐ OTHERS		
SUPERVISION	SUPERVISION FOR COMMISSIONING AT PROJECT SITE	REQUIRED ☐ NOT REQUIRED		
	NO OF MAN DAYS	MAN DAYS		

*IF THE LOCATION IS INDOOR, KINDLY SPECIFY IF PLC PANEL IS PLACED IN AC OR NON-AC ENVIRONMENT.

**SHALL NOT BE APPLICABLE IF TEMPERATURE TRANSMITTERS ARE ENVISAGED.

PROJECT SPECIFIC PAINT SHADES, IF APPLICABLE TO BE USED.

\$\$ CHECK & REPLACE WITH MAIN UPS SLD IF POWER SUPPLY IS NOT APPROVED BY CUSTOMER.



Notes:

- 1) The printer shall be a network printer.
- 2) Minimum speed of communication bus shall be 100 Mbps.

FOR TENDER PURPOSE ONLY

 नैशनल थर्मल पावर कॉर्पोरेशन लिमिटेड National Thermal Power Corporation Ltd. A GOVERNMENT OF INDIA ENTERPRISE ENGINEERING DIVISION		PROJECT		TYPICAL THERMAL POWER PROJECT	
TITLE		STANDARD CONFIGURATION DIAGRAM FOR PLC BASED OFFSITE CONTROL SYSTEMS			
SIZE	A3	SCALE	DATE	REV. NO.	A
DESCRIPTION		CLEARED BY		0000-999-POI-A-013	



**C&I SPECIFICATION FOR
HYDROGEN GENERATION PLANT**

SECTION: C
SUB SECTION: C&I

**DATA SHEETS FOR MOTORISED VALVE
ACTUATOR**



SPECIFICATION FOR MOTORISED VALVE ACTUATOR

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SHEET 1 OF 4

Data Sheet A & B

DATA SHEET-A
(TO BE FILLED BY PURCHASER)

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

GENERAL*	* PROJECT	3 x 800 MW PATRATU TPP			
	OFFER REFERENCE				
	* TAG NO. SERVICE				
	* DUTY	☐ ON / OFF ☐ INCHING			
	* LINE SIZE (inlet/outlet): MATERIAL				
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY			
	* OPENING / CLOSING TIME				
	* WORKING PRESSURE				
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%			
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY			
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY			
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY			
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, 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 90% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. FOR INCHING /REGULATING SERVICE - 150 STARTS/HR MINIMUM.			
HANDWHEEL	* REQUIRED	☒ YES ☐ NO			
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED			
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.				
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY			
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY			
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT- INCLUSIVE OF I.S. TOLERANCE			
	ACTUATOR APPLICABLE WIRING DIAGRAM	☒ ENCLOSED (BIDDER TO CONFIRM) A: ☐ DRG. NO. 3-V-MISC-24227 R00 B: ☐ DRG. NO. 3-V-MISC-24550 R00 C: ☐ DRG. NO. 3-V-MISC-24283 R00 D: ☐ DRG. NO. 4-V-MISC-90271 R11 E: ☐ For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram			
	COLOUR SHADE	☒ BLUE (RAL 5012) ENAMEL ☐			
	PAINT TYPE (## Refer Notes)	☐ ENAMEL ☐ EPOXY ☐			
	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 +/- 10 % , 3PH,3 W, AC 50 HZ +/- 5 %			
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ☒ 110 V AC/24V DC			

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR				
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		SHEET	2	OF	4
Data Sheet A & B					
DATA SHEET-A (TO BE FILLED BY PURCHASER)				DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
	MOTOR BEARING WITH 2 EARTH TERMINALS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI FRICTION			
	@ ENCLOSURE CLASS OF MOTOR	IP 67 FOR OUTDOOR & IP 55 FOR INDOOR(TOTALLY ENCLOSED SELF VENTILATED)			
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B			
	@ WINDING TEMP PROTECTION	☒ THERMOSTAT (3 Nos.,1 IN EACH PHASE) ☐			
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED			
INTEGRAL STARTER	INTEGRAL STARTER	☒ REQUIRED ☐ NOT REQUIRED			
	TYPE OF SWITCHING DEVICE	☒ CONTACTORS ☐ THYRISTORS			
	TYPE	☒ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)			
	IF SMART	(NOT APPLICABLE)			
	a) SERIAL LINK INTERFACE	☐ INTEGRAL ☐ FIELD MOUNTED			
	b) SERIAL LINK PROTOCOL	☐ FOUNDATION FIELD-BUS ☐ PROFI-BUS ☐ DEVICE NET ☐			
	c) SERIAL LINK MEDIA	☐ TWISTED PAIR Cu-CBL ☐ CO-AXIAL Cu-CBL ☐ OFC			
	d) HAND HELD PROGRAMMER	☐ REQUIRED ☐ NOT REQUIRED			
	e) TYPE OF HAND HELD PROGRAMMER	☐ BLUETOOTH ☐ INFRARED ☐			
	f) MASTER STATION	☐ REQUIRED ☐ NOT REQUIRED			
	g) MASTER STN INTRFACE WITH DCS	☐ MODBUS ☐ TCP/IP			
	h) DETAILS OF SPECIAL CABLE	☐ ENCLOSED ☐ NOT REQUIRED			
	STEP DOWN CONT. TRANSFORMER	☒ REQUIRED			
	OPEN / CLOSE PB	☒ REQUIRED ☐ NOT REQUIRED			
	STOP PB	☒ REQUIRED ☐ NOT REQUIRED			
	INDICATING LAMPS	☒ REQUIRED ☐ NOT REQUIRED			
	LOCAL REMOTE S/S	☒ REQUIRED ☐ NOT REQUIRED			
	STATUS CONTACTS FOR MONITORING	☒ REQUIRED ☐ NOT REQUIRED			
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY)			
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	☒ INTERPOSING RELAY ☐ OPTO COUPLER ☐ EITHER			
	QUANTITY	☒ 2 Nos. ☐ 3 Nos.			
	DRIVING VOLTAGE	☒ 20.5 – 24V DC ☐ _____ V DC			
	DRIVING CURRENT	☒ 125mA MAX ☐ _____ mA MAX			
	LOAD RESISTANCE	☒ > 192 ohms - <25 k ohms ☐ > _____ ohms - < _____ ohms			
TORQUE SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY			
	OPEN / CLOSE	☒ 1 No. ☐ 2Nos. / ☒ 1 No. ☐ 2Nos			
	CONTACT TYPE	2 NO + 2 NC			
	RATING	5A 240V AC AND 0.5A 220V DC			
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE			
	ACCURACY	+3% OF SET VALUE			
LIMIT SWITCH (Not Applicable for Smart Actuator) (\$\$	MFR & MODEL NO.	BIDDER TO SPECIFY			
	OPEN : INT : CLOSE	☐ 1 No ☒ 2 Nos.	☐ 1 No. ☒ 2Nos.		
	CONTACT TYPE	2 NO + 2 NC			

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR			
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		SHEET	3	OF 4
Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
Refer Notes)	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC		
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.				

POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty applications)	☒ REQUIRED ☐ NOT REQUIRED	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	☐ ELECTRONIC (2 WIRE) R/I CONVERTER ☒ ELECTRONIC (2 WIRE) CONTACTLESS INDUCTIVE TYPE ,EXTERNAL 24 V DC OPERATED ,SUITABLE FOR STABILISED 4-20 mA SIGNAL	
	SUPPLY	☒ 24V DC ☐	
	OUTPUT	☒ 4-20mA	
	ACCURACY	± 1% FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON INTEGRAL)	230V AC,1 PH.,50 Hz	
	@ POWER SUPPLY (INTEGRAL)	POWER SUPPLY DERIVED FROM MAIN POWER SUPPLY AVAILABLE AT ACTUATOR END.	
	@ RATING		
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	☒ IP 68 @ ☐	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET(9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	☒ REQUIRED ☐ NOT REQUIRED ☒ 2 NOS. PRE WIRED ☐	
CABLE GLANDS	@ POWER CABLE GLAND	SIZE:-----	
	@ SPACE HEATER CABLE GLAND	SIZE:-----	
	OTHER CONTROL CABLE GLANDS-1	☐ 1No. for BFV of CW PUMP(Cable size 2Px1.5mm2)	
	OTHER CONTROL CABLE GLANDS-2	QUANTITY & SIZE :-----	

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR			
			REV. NO.	00
		SHEET	4	OF 4
Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
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. 8. IT SHALL BE POSSIBLE TO OPERATE THE ACTUATOR LOCALLY. LOCKABLE LOCAL/REMOTE SELECTION SHALL BE PROVIDED ON THE ACTUATOR. 9. POSITION INDICATOR SHALL BE PROVIDED FOR 0 TO 100 % TRAVEL 10. WIRING SHALL BE SUITABLE VOLTAGE GRADE COPPER WIRE.				
NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL
	Madhav gupta	Mayank kesharwani	Bharat Singh	NAME
				SIGNATURE
	01.03.2018	01.03.2018	01.03.2018	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.

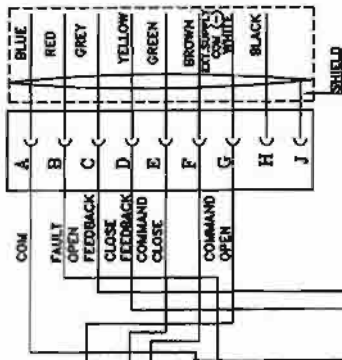
3-V-MISC-24283

CONTACT DEVELOPMENT DIAGRAM

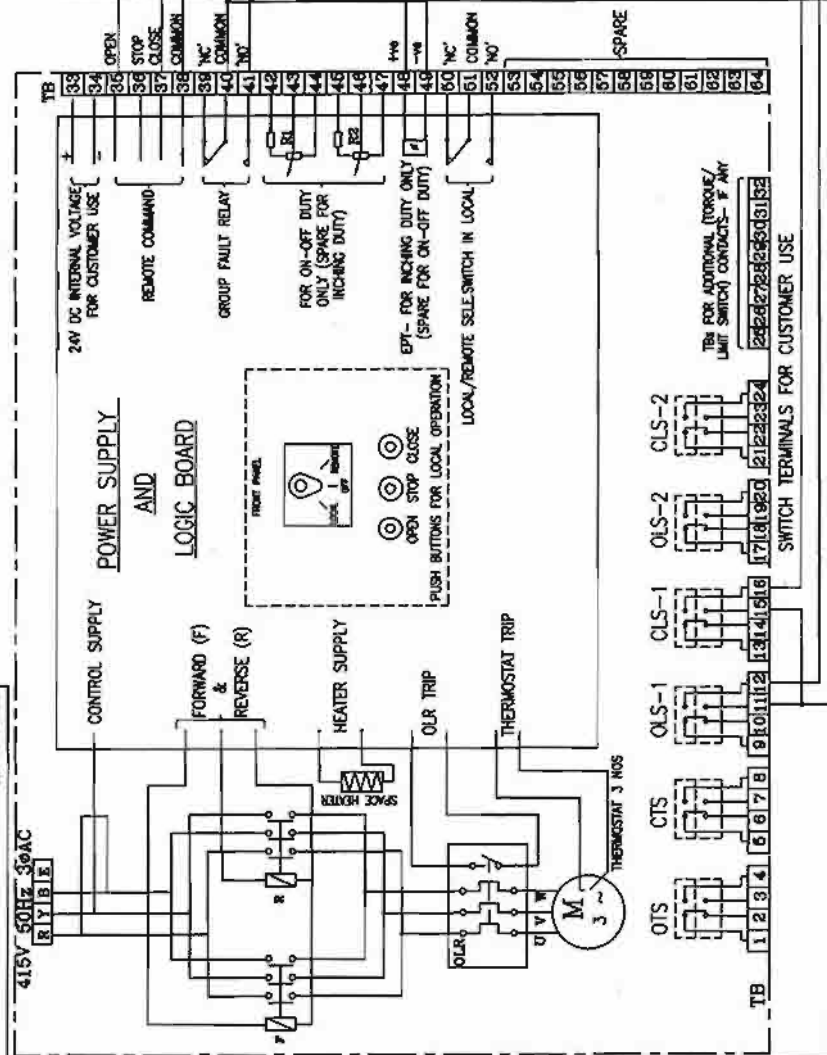
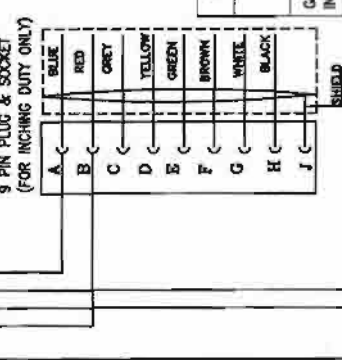
OTS	1-2	OPEN AT OVER TORQUE DURING OPENING TRAVEL
CTS	3-4	CLOSE AT OVER TORQUE DURING OPENING TRAVEL
CLS-1	5-6	OPEN AT OVER TORQUE DURING CLOSING TRAVEL
CLS-2	7-8	CLOSE AT OVER TORQUE DURING CLOSING TRAVEL
CLS-1	9-10	---
CLS-2	11-12	---
CLS-1	13-14	---
CLS-2	15-16	---
CLS-1	17-18	---
CLS-2	19-20	---
CLS-1	21-22	---
CLS-2	23-24	---
TERMINAL NO.	0	INTERMEDIATE
SWITCH	1	FULL CLOSE

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

9 PIN PLUG & SOCKET
 (FOR ALL ACTUATORS)



ADDITIONAL
 9 PIN PLUG & SOCKET
 (FOR INCHING DUTY ONLY)



VALVES	SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH		
	OPEN	CLOSE	BACK UP
GATE VALVE OF 100 mm AND ABOVE	CLS	OTS	CLS
IN 1500 CL AND ABOVE RATINGS	CLS	OTS	CLS
ALL OTHER GATE & GLOBE VALVES	CLS	OTS	CLS

CLS NOT TO BE CONNECTED IN TRIP CIRCUIT
 BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)

TYPE OF PRODUCT
 OR NAME OF
 CUSTOMER/PROJECT

ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS
 FOR NTPC PROJECTS
 (DRAWN FOR INTERMEDIATE POSITION OF VALVES)

NAME	DATE	NO. OF VAR.
N.P.ESWAR	17.03.05	
D.DINAKARAN	17.03.05	
KARUNACHALAM	17.03.05	

DESIGN	SCALE	WEIGHT (KG)	REFERENCE INFORMATION
385-121	NTS		
CODE	NTS		

CAUTION: The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any way that may be detrimental to the interest of the company.

REV	DATE	ALTERED	CHD & APPD

- NOTE:-
- ALL TORQUE AND LIMIT SWITCHES (OTS, CTS, CLS1&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)
 - CLS-1, CLS-2 - LIMIT SWITCHES FOR POSITION OPEN
 - CLS-1, CLS-2 - LIMIT SWITCHES 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.



**C&I SPECIFICATION FOR
HYDROGEN GENERATION PLANT**

SECTION: C
SUB SECTION: C&I

UPS SPECIFICATION

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	ELECTRICAL POWER SUPPLY SYSTEM			
1.00.00	ELECTRICAL POWER SUPPLY			
1.01.00	The requirements of Electrical Power Supply system are specified herein on system basis. The Contractor shall be responsible for engineering and furnishing a complete and operational system fully meeting the intent and requirements of this specification including tender drawings and Employer approved drawings during detailed engineering. All equipment and accessories required for completeness of this system shall be furnished by the Contractor whether these are specifically mentioned herein or not. All the equipments and sub systems offered shall be from reputed experienced manufacturers. All system cabinets, enclosures, & distribution boards shall be manufactured, assembled, wired and fully tested as a complete assembly as per the requirements of this specification at the manufacturer's works. The Contractor shall furnish all required equipment cubicles and wiring required for conversion and/or stabilization of the power sources provided by the Employer to all other levels which may be necessary for meeting the individual requirement of equipment/system furnished by him including the panel/desk mounted equipment.			
1.02.00	The power supply system shall be designed to meet the electrical power requirements of various C&I systems including DDCMIS. The Power Supply System shall be designed to give the voltage at approximate mid level of the tolerance band of the power supply modules/packs of Control System, when the charger is feeding the load. This shall also take in consideration the voltage drop in cables from DCDB to the control panels. In case the Power Supply Output of a charger exceeds the voltage band tolerated by the power supply modules/packs of Control System, provision for safe tripping of that charger is to be ensured.			
1.03.00	The DC Power Supply for various sub-systems shall consist of one or more of the following configurations. The applicable configurations are as indicated in Appendix-1 to Part-A of contract quantities: - (A) NOT USED. (B1) DC power supply system for UNIT (BOP) Area: DC power supply system shall comprise of two sets. Each set shall consist of 1 x 100% microprocessor controlled, intelligent, modular rectifier banks, Controller –one for each rectifier bank, 1 x 100% batteries for one (1) hour duty, 1 X 100% DC distribution board. 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS)–common for both the sets. Contractor has the option of supplying either Nickel Cadmium type batteries or Lead Acid Plante type batteries for this configuration. The specifications for this DC Power Supply System shall be as per Cl.No.2.01.00 to 2.03.00 and specifications for Battery shall be as per Cl. No 4.00.00 for Ni-Cd type Batteries & 5.00.00 for Lead Acid Plante type Batteries. ~~(B2) DC power supply system for areas other than Unit (BOP) : DC power supply system shall comprise of two sets. Each set shall consist of 1 x 100% microprocessor controlled, intelligent, modular rectifier banks, Controller –one for each rectifier bank, 1 x 100% Nickel - Cadmium batteries for one (1) hour duty, 1 X 100% DC distribution board. 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS)–common for both the sets.~~			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-05 POWER SUPPLY	PAGE 1 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	The specifications for this DC Power Supply System shall be as per Cl.No.2.01.00 to 2.03.00 and specifications for Battery shall be as per Cl. No 4.00.00 for Ni-Cd type Batteries			
	(C) DC power supply system shall comprise of 2 x100% power supply unit along with 1x100% sealed maintenance free lead Acid batteries for 30 Min back up and DC Distribution Board. DC power supply unit along with batteries shall be housed in a single panel. The power supply unit shall be capable of charging the batteries and feeding the load simultaneously. The DC distribution board shall have redundant feeders for critical loads. The specifications for this configuration shall be as per Cl.No.2.04.00.			
	(D) DC power supply system shall consist of one set of 24 VDC redundant power supply system with battery back up as per the process requirement. In case power supply module/power packs with 24 VDC output are used, the input power supply to the same can be either of 24 VDC/110 VAC/230 VAC/220 VDC, to be finalized during detailed engineering. The specifications for this configuration shall be as per manufacturer's standard Bidder shall clearly bring out in the proposal the redundancy features along with configuration diagram, single line diagram & data sheets etc. and this shall be finalized and subject to Employer's approval during detailed engineering.			
1.04.00	NOT USED.			
1.05.00	The UPS Power Supply for various sub-systems shall consist of one or more of the following configurations. The applicable configurations are as indicated in Appendix-1 to Part-A of contract quantities. Bidder shall clearly bring out in the proposal the redundancy feature along with configuration diagram, single line diagram and data sheets etc. & this shall be finalized subject to employer's approval during detailed engineering. ~~(A) UPS System shall consist of 2 x 100% parallel redundant chargers and inverters with input isolation transformers, 1 x 100% battery bank for one (1) hour, Bypass line transformers & voltage stabilizer, static switch manual bypass switch, 2 x 100% ACDB, 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS) and other necessary protective devices and accessories.~~ Contractor has the option of supplying either Nickel Cadmium type batteries or Lead Acid Plante type batteries for this configuration. The specifications for this UPS configuration shall be as per Cl.No.3.00.00 to 3.05.00 and specifications for Battery shall be as per Cl. No 4.00.00 for Ni-Cd type Batteries & 5.00.00 for Lead Acid Plante type Batteries. (B) UPS system shall consist of 1 x 100% charger and inverter, 1 x 100% Ni Cd Battery Bank for 1 hour, Bypass Line Transformers and Voltage Stabilizer, static switch, manual bypass switch, 2 x 100% ACDB, 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS) and other necessary protective devices and accessories. The specifications for this UPS configuration shall be as per Cl.No. 3.00.00 to 3.05.00 and specifications for Battery shall be as per Cl. No 4.00.00 for Ni-Cd type Batteries.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-05 POWER SUPPLY	PAGE 2 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.06.00	For distribution of UPS Supply , Contractor shall provide PDBs. The number of PDB's shall be as per Appendix-1 to Part-A of contract quantities. PDBs which are to be used for the distribution of UPS Supply for HMI peripherals shall have Static Switches mounted inside the PDB for change over. PDBs which are to be used for the distribution of UPS Supply for all other loads shall have Auto Change over circuitry without static switches implemented inside the PDBs. For distribution of UPS Supply in the offsite areas, separate PDBs are not envisaged. Each PDB shall be provided with input feeder monitoring through potential free contact wired to DDCMIS. The output feeders from the PDB shall be provided with separate fuse & MCB's. 10% spare feeders (min. 1 no.) with MCB & fuses for each rating shall be provided in Bidder's each PDB. The PDBs provided for distribution of UPS loads shall be as per following guidelines. ~~(a) For Main Plant HMI Loads, half of the HMI load shall be distributed through one set of static switches with input from both the ACDB's while the other half of the HMI load shall be distributed through other identical set of static switches.~~ (b) For offsite Area HMI & other loads which accept redundant inputs shall be fed directly from redundant ACDB feeders. The loads which accept only single input feeder shall be divided between the two ACDB's such that even in event of unavailability of one ACDB, half of the devices/peripherals are available.			
1.07.00	NOT USED			
2.00.00	DC POWER SUPPLY SYSTEM (24 V),			
2.01.00	Microprocessor based, Intelligent, Modular Power Supply			
	The minimum capacity of the modular power supply inclusive of 10% design margin shall be as indicated in Appendix-I to Part A of the specification.			
2.01.01	Microprocessor based, Intelligent, Modular Power Supply shall be sized for continuous duty to meet 100% load requirements and keep the connected battery fully charged in float mode. The minimum capacity inclusive of 10% design margin shall be as indicated in Appendix-1 to contract quantity Part-A of the specification. Either of the bank of rectifier modules shall be able to re-charge the fully discharged battery within 8 hours. It shall also be possible to discharge batteries periodically manually. Each rectifier bank shall be provided with N+1 rectifier modules and the maximum numbers of rectifier modules shall not be more than 25 Nos. However, the exact number of rectifier modules shall be as finalized by the Employer during Detailed Engineering. The exact sizing of the rectifiers in one bank shall be subject to Employer approval during detailed engineering. It shall be ensured that all rectifier modules in one rectifier bank shall be of same rating and not more than three ratings of rectifier modules shall be used in various rectifier banks. Provision for manual boost charging with isolation of loads shall be provided.. While sizing, the temperature derating factor as applicable, is to be considered for arriving at the rating of the modules as per Bidder's manufacturing standard if the modules are rated for lower than the 50 deg. C ambient. For the rectifier bank, matching controller along with applicable software shall be provided to meet system requirements under all modes of operation."			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIIC-05 POWER SUPPLY	PAGE 3 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
2.01.02	The rectifier module shall be microprocessor controlled, IGBT/ Power MOSFET based, high frequency with active load sharing, designed for single and parallel operation with battery and shall have automatic voltage regulators for a close voltage stability even when AC supply voltage and DC load fluctuates, effective current limiting features, front access design, programmable temperature compensation feature for battery charging and filters on both input and output to minimise harmonics. The rectifier module output regulation shall be ± 1% or better from no load to full load with an input power supply variation of ± 10% in voltage and ± 5% in frequency. In addition to indications/display on charger panel, alarms shall also be provided by employing RS 485 Port Modbus Protocol / Ethernet TCP/IP protocol for use in DDCMIS. Further isolated 4-20 mA signals shall be provided for important parameters like rectifier bank voltage, rectifier bank current, battery voltage, battery current, DCDB Voltage, DCDB current etc. The list of alarm output & 4-20 mA signals shall be as approved by Employer during detailed engineering. Necessary provision shall be done in DDCMIS end also.		
2.01.03	The rectifier module shall be fed from 415V AC, 50 HZ, 3 phase, 3 wire system.		
2.01.04	"Float/Boost" charge functions shall be provided with alarm/indications.		
2.01.05	The rectifier module circuitry shall be of fail-safe design and failure of any component should not result in any rectifier bank output voltage to increase beyond acceptable limits of the C&I system being fed from it.		
2.01.06	The rectifier module shall be current limited for circuit protection and protection of battery from overcharge. The current limit shall be continuously programmable.		
2.01.07	The rectifier module shall have a slow walk-in circuit which shall prevent application of full load DC current in less than 10 seconds after AC power is energised.		
2.01.08	The full load efficiency of rectifier module at nominal input and output shall be at least 90%. The ripple content shall be limited to +/- 0.5 % of output voltage.		
2.01.09	The Controller shall be microprocessor controlled for monitoring & control of rectifier modules with features viz. Auto/Manual battery discharge test, battery reserve time prediction, energy management, float/boost mode control etc.		
2.01.10	All Software as required for smooth operation and monitoring of rectifier modules in conjunction with Controller & BHMS shall be provided by the Contractor.		
2.01.11	Contractor shall furnish the equipment complete in all respects along with rectifier module rating & voltage drop calculations, supporting curves/data etc.		
2.02.00	DC Distribution Board (DCDB) Redundant DC feeders (one from each DCDB) shall supply each of the connected loads. The exact design, rating & number of feeders of the each redundant DCDB shall be as finalised during detailed engineering and as approved by Employer. However, 25% spare feeders (min. 1 no.) with MCB and fuses for each rating shall be provided in each DCDB.		
2.03.00	Battery Health Monitoring System (BHMS) BHMS, wherever applicable, shall include microprocessor based hardware and software to monitor the condition of each battery cell of 24 V DC systems & UPS battery banks on-line. With BHMS it shall be possible to measure & analyse the minimum and maximum voltage		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-05 POWER SUPPLY
			PAGE 4 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	values of each battery-cell so that any damage to battery shall be prevented by pro-active maintenance. BHMS shall communicate with the DDCMIS and provide alarms as finalized by Employer during detailed engineering. Contractor to ensure that the configuration of the BHMS system being supplied along with the batteries of 24 V DC Charger System and UPS System shall meet the technical requirements of the type of batteries supplied along with these power supply systems.			
2.04.00	Power Supply shall be sized to meet connected load requirements and keep the connected battery full charged in Float/ Boost mode. The rectifier module output regulation shall be $\pm 1\%$ or better from no load to full load with an input power supply variation of $\pm 10\%$ in voltage and $\pm 5\%$ in frequency. In addition to indications/display on the panel, potential free contacts for alarms like O/P voltage high & low, AC Input supply failure, battery feeding the load etc shall also be provided for use in respective control system i.e., PLC/Remote IO etc . Further isolated 4-20 mA signals shall be provided for important parameters like rectifier module voltage, rectifier bank current, battery voltage etc. The list of alarm output & 4-20 mA signals shall be as approved by Employer during detailed engineering. The exact design, rating & number of feeders of the DCDB shall be as finalised during detailed engineering and as approved by Employer. However, 25% spare feeder (min. 1 no.) with fuses for each rating shall be provided in each DCDB.			
3.00.00	UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEM The minimum capacity of the UPS at load factor of 0.8 lagging inclusive of 10% design margin at 50 deg c shall be as indicated in Appendix-I to Part-A of the specification. The UPS system shall meet the following requirements as a minimum. If UPS KVA rating is applicable at a lower ambient temperature than specified 50 deg.c, the bidder shall consider a derating factor of at least 1.5%/deg.c for arriving at the specified UPS capacity at 50 deg.c ambient. The UPS shall have an overload capacity of 125 % rated capacity for 10 minutes and 150 % rated capacity for 10 seconds. The inverter shall have sufficient capability to clear fault in the maximum rated branch circuit, limited to 8 percent of finally selected ups capacity.			
3.01.00	Chargers			
3.01.01	The chargers shall be self regulating, solid state silicon controlled, full-wave rectifier type designed for single and parallel operation with battery and shall have automatic voltage regulators for close voltage stability even when AC supply voltage fluctuates, effective current limiting features and filters to minimise harmonics. The charger should be capable to fully charge the required batteries as well as supply the full rated load through inverter. Furthermore the charger should be able to re-charge the fully discharged battery within 8 hours. The charger output regulation shall be $\pm 1\%$ from no load to full load with an input power supply variation of $\pm 10\%$ in voltage and $\pm 5\%$ in frequency. In addition to indications/display on charger panel, alarms along with relevant analog measurements shall also be provided by employing RS 485 Port Modbus Protocol / Ethernet TCP/IP protocol for use in DDCMIS. The list of alarm output & 4-20 mA signals shall be as approved by Employer during detailed engineering.			
3.01.02	The charger shall be current limited for charger circuit protection and protection of battery from overcharge shall also be provided. The current limit shall be continuously adjustable. The chargers shall have a slow walk-in circuit which shall prevent application of full load DC current in less than 10 seconds after AC power is energised.			
3.01.03	The chargers shall be fed from 415V AC, 50 HZ, 3 phase, 3 wire system. Charger design shall ensure that there is no component failure due to fluctuations of input supply or loss of			
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	supply and restoration.		
3.01.04	The minimum full load efficiency at nominal input and output shall be 90%. The ripple content shall be limited to +/- 2 % of Charger output voltage.		
3.01.05	The UPS battery shall have sufficient amp-hour capacity to supply the steady state KVA rating of the UPS specified for 60 minute, irrespective of the actual load on UPS.		
3.01.06	The UPS system shall be capable of operating without D.C. battery in circuit under all conditions of load and the performance of various components of UPS like inverter, charger, static switch etc. shall be guaranteed without the battery in circuit.		
3.01.07	The UPS system design shall ensure that in case of failure of mains input power supply to one of the chargers, the other charger whose mains input power supply is healthy, shall feed to one or both the inverters as the case may be as per manufacturer's standard practice & continue to charge the D.C. battery at all load conditions. The Bidder should note that this situation should not in any way lead to the discharge of the D.C. Battery.		
3.02.00	Static Inverters The static inverter shall be of continuous duty, solid state type using proven Pulse Width Modulation (PWM)/Quasi square wave/step wave technique. Ferro-resonant types Inverters are not acceptable. The nominal voltage output shall be 230 Volts. single phase ,50 Hz. The inverter equipment shall include all necessary circuitry and devices to conform to requirements like voltage regulation, current limiting, wave shaping, transient recovery, automatic synchronization etc. The steady state voltage regulation shall be +/-2% and transient voltage regulation (on application/removal of 100% load) shall be +/-20%. Time to recover from transient to normal voltage shall not be more than 50 mSec. Frequency regulation for all conditions of input supplies, loads and temperature occurring simultaneously or in any combination shall be better than ± 0.5% (automatically controlled). The total harmonic content shall be 5% maximum and content of any single harmonic shall be 3% maximum. The inverter efficiency shall be at least 85% on full load and 80% on 50% load. The synchronisation limit for maintenance of synchronisation between the inverter and stand by AC source shall be 48-52Hz, field adjustable in steps of 1 Hz.		
3.03.00	Static Switch and Manual Bypass Switch The static switch shall be provided to perform the function of transferring UPS loads automatically without any break from (i) faulty inverter to healthy inverter in case of failure of one of the two inverters and (ii) from faulty inverter to standby AC source in case of failure of both the inverters. The transfer time shall be ¼ cycle maximum in synchronous mode. Manual bypass switch shall be employed for isolating the UPS during maintenance. Continuous and overload capacity of the switches shall be equal to 100% of the continuous and overload rating of each inverter. Peak Capacity shall be 1000% of continuous rating for 5 cycles.		
3.04.00	Step Down Transformer and Voltage Stabiliser One 415V three phase to 230V, single phase transformer along with associated voltage stablizer shall be furnished with each UPS system. The transformer and stablizer combination shall convert Employer furnished 415V ± 10% three phase plant auxiliary AC supply to 230 V ± 2%, single phase standby AC Power Supply source.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-05 POWER SUPPLY
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.05.00	The transformer shall be of low impedance air-cooled type and its KVA rating and percentage impedance should be selected so that extremely fast fault clearance is achieved. The overload capacity of the transformer and voltage stabilizer shall not be less than 300% for 200 millisecond duration. The voltage stabilizer shall employ servo-controlled circuitry and shall maintain the specified output voltage for 0-100% load with maximum input voltage variations as indicated above. The efficiency of the stabiliser shall be 95% or better. The type and other details shall be subject to Employer's approval.			
	AC Distribution Board (ACDB) The details of the AC distribution board, i.e. exact, rating and number of feeders etc. of the 2x100% ACDB shall be as indicated in Appendix-1 to contract quantity, Part-A of the specification and as approved by Employer during detailed engineering . ACDB shall be designed to cater to the requirements of both Employer's System and Contractors systems.			
	4.00.00	Batteries		
4.01.00	Nickel Cadmium Batteries			
4.01.01	The batteries shall be heavy duty Nickel-cadmium type and shall be sized for one hour of full load operation during non-availability of AC supply / chargers. The Ni-Cd batteries shall strictly conform to the latest edition of IS: 10918 including all applicable official amendments and revisions as on date of opening of techno-commercial bid. For sizing calculation, an aging factor of 0.8 and a temperature correction factor as per manufacturer's standard at 4 deg. C electrolyte temperature (Based on temperature characteristics curve to be submitted by the Contractor at a temperature of 4 deg. C), Capacity factor, float correction (if applicable) shall be taken into consideration. The sizing of the battery shall be as approved by Employer during detailed engineering. The Contractor shall typically consider a voltage drop of 2.5V from battery room to DCDB and DCDB to load, while sizing the battery for 24 V DC Charger System and 4V from battery room to the inverter input while sizing the battery for UPS System.			
4.01.02	Connectors and Fasteners Nickel plated copper connectors shall be used for connecting adjacent cells and PVC insulated flexible copper cables shall be used for inter-row / inter-tier / inter-bank connections. Bolts, nuts and washers shall be Stainless Steel / Nickel coated steel to prevent corrosion. All the terminals and cells inter-connectors shall be fully insulated or have insulation shrouds. Necessary supports and lugs for termination of these cables on batteries shall also be supplied by the contractor. All connectors and lugs shall be capable of continuously carrying the 60 minutes discharge current of the respective batteries and fault short circuit current which the battery can produce and withstand for the period declared.			
4.01.03	Manufacturer's Identification Systems The following information shall be indelibly marked on outside of each cell. (a.) Manufacturer's name and trade marks (b.) Country and year of manufacture. (c.) Manufacturer type designation.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2		SUB-SECTION-IIIC-05 POWER SUPPLY
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CLAUSE NO.	TECHNICAL REQUIREMENTS 		
4.02.00 4.02.01 4.02.02 4.02.03	(d.) AH capacity at 5 hour discharge rate. (e.) Serial number Lead Acid Plante Batteries Codes & Standards All standards, specification and codes of practice, referred to herein, shall be the latest edition including all applicable official amendments and revisions as on date of opening of techno-commercial bid. In case of conflict between this specification and those (IS Codes Standards etc.) referred to herein, the former shall prevail. All works shall be carried out as per the following standards and codes: IS : 266 Specification for sulphuric acid IS : 1069 Specification for water for storage batteries IS : 1146 Specification for rubber & plastic containers for lead acid storage batteries. IS : 1652 Specification for stationary cells and batteries, lead acid type (with plante positive plates). IS : 3116 Specification for sealing compound for lead acid batteries. IS : 8320 General requirements and methods of tests for lead acid storage batteries. IS : 6071 Specification for synthetic separators for lead acid batteries. Indian Electricity Rules Indian Electricity Acts Equipment complying with other internationally accepted standards such as IEC, BS, VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards alongwith copies of all official amendments and revisions in force as on date of opening of techno-commercial bid and shall clearly bring out the salient features for comparison.		
	EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)	TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-05 POWER SUPPLY PAGE 8 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.02.04	GENERAL TECHNICAL REQUIREMENTS			
4.02.04.01	Equipments			
	DC Batteries shall be stationary lead acid Plante positive plate type conforming to IS:1652. The battery shall be high discharge performance type shall be sized for one hour of full load operation during non-availability of AC supply / chargers. For the purpose of sizing Temperature Correction Factor as per manufacturer's standard at 4 Deg C electrolyte temperature, relative humidity of 95%, aging factor of 0.8 and Capacity Factor shall be considered. The Contractor shall furnish relevant charts, curves, tables etc. in support of the various factors considered during battery sizing. DC Batteries shall be suitable for standby duty. The Batteries shall normally be permanently connected to the load in parallel with a charger and shall supply the load during emergency conditions when AC supplies are lost. Batteries shall be suitable for a long life under continuous float operations and occasional discharges. The batteries shall be boost charged at about 2.7 volts per cell maximum and float charged at about 2.25 V/cell: The number of cells for the 24 V DC Charger System and UPS System shall be decided during detailed engineering.			
4.02.04.02	Connectors and Fasteners			
	Lead or Lead coated copper connectors shall be used for connecting up adjacent cells and rows. Bolts, nuts and washers shall be effectively lead coated to prevent corrosion. All the terminals and cells inter-connectors shall be fully insulated or have insulation shrouds. Necessary supports and lugs for termination of these cables on batteries shall also be supplied by the contractor. All connectors and lugs shall be capable of continuously carrying the 60 minutes discharge current of the respective Batteries and fault short circuit current which the battery can produce and withstand for the period declared.			
4.02.04.03	Manufacturer's Identification Systems			
	The following information shall be indelibly marked on outside of each cell. (f.) Manufacturer's name and trade marks (g.) Country and year of manufacture. (h.) Manufacturer type designation. (i.) AH capacity at 10 hour discharge rate. (j.) Serial number			
5.00.00	AUXILIARY EQUIPMENTS			
5.01.00	All required auxiliary equipment/materials as finalised during detailed engineering shall be furnished with each rectifier bank, UPS & battery bank and shall include as a minimum various meters (AC/DC voltage/current, kVA, power factor, frequency meters etc), circuit breakers, selector switches, push buttons indicating lights, ground detector system, battery accessories like (inter cell connectors, inter step connectors, battery racks etc.) isolated 4-20 mA signals for important parameters and potential free contacts for important alarms shall be provided for use in DDCMIS.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-05 POWER SUPPLY	PAGE 9 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
5.02.00	Manual Discharge Resistance bank of adequate capacity for UPS & 24 V DC Power Supply System batteries as indicated in Appendix-1 to Part-A of contract quantities shall be provided by the Contractor.		
5.03.00	Accessories and devices required for maintenance and testing of batteries shall be supplied as per Appendix-1 to Part-A of Contract Quantities.		
6.00.00	Battery Racks The battery racks shall be constructed from high strength good quality mild steel sections. Battery Racks should either be epoxy painted or epoxy powder coated with three (3) coats, with acid resistant grade of pigment as per approved coating process to provide a non-peel able protective coat. The racks shall be of single tier/ two tier construction depending on the final layout based on space availability.		
7.00.00	DRAWINGS/DOCUMENTS REQUIREMENTS Bidder shall furnish the power supply distribution scheme, single line diagram, all calculations such as Rectifier Modules / UPS Charger / Inverter rating calculations, battery sizing calculation etc. for DC system as well as for UPS during detailed engineering for Employer's review and approval.		
8.00.00	CABINETS / ENCLOSURES / POWER DISTRIBUTION BOXES The Construction details for Power Supply System Cabinets/ Enclosure/Racks shall conform to the requirements of the following paragraphs. (1) Equipment enclosures shall match and line up in assemblies of freestanding floor mounted cabinets designed for indoor service. (2) Individual enclosure shall be ventilated switchboard type fabricated from not less than 1.6-mm thick sheet steel. Enclosures shall be furnished with concealed hinges. Front and rear doors shall be designed to permit easy access to all components for maintenance or replacement. The enclosures shall be reinforced with formed steel members as required to form a rigid self-supporting structure. Doors shall have three point latches. (3) Each assembly may be shipped in sections for ease of handling and field assembly. Terminal blocks shall be furnished as required adjacent to each shipping split to facilitate field assembly. Cable bundles cut to the required length and furnished with terminal lugs tagged for identification shall be provided for the wiring between shipping sections. (4) Adequate ventilating louvers and enclosure top panels shall be included. All vent openings shall be covered with corrosion resistant fine screen coverings. (5) The temperature rise inside all the cabinets/enclosures shall not exceed 10 deg.C above ambient temperature. The cabinets shall be IP-22 protection class . (6) The Colour shade of Panels exterior/interior shall be as per RAL 9002, end panel Colour shall be as per RAL 5012.		
9.00.00	COOLING SYSTEM If the equipment supplied requires forced air cooling, the cooling system furnished shall meet the following requirements: (1) Reserve cooling equipment shall be furnished for each assembly. Reserve fan(s) capacity shall be equal to 100 percent of cooling fan requirements for full load operation with only one bank of rectifier/inverter in service at the specified maximum		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-05 POWER SUPPLY
			PAGE 10 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
11.00.00 11.01.00 11.01.01	ambient temperature. (2) Completely independent duplicable wiring and control systems shall be provided for the normal cooling fan system and the reserve cooling fan system. (3) Each cooling fan shall normally run continuously and shall be powered from the output of the inverter whose enclosure it serves (for cubicles housing inverters). For other cubicles, fan power supply shall be as finalised during detailed engineering. Each cooling fan supply circuit shall be separately fused. (4) Each cooling fan shall be equipped with a switch having an alarm contact that closes upon failure of airflow or rise of temperature. SITE TESTS The Contractor shall also carry out the site tests on equipments/systems as specified below..However, these shall not be limited to this specification only and in case any other site test is required to be conducted as a standard practice of the Contractor or deemed necessary by the Employer and mutually agreed between the Contractor and the Employer, the same shall also be carried out. Uninterruptible Power Supply System Functional Test On completion of installation and commissioning of the equipment the following tests/checks shall be carried out with the max. available load, which does not exceed the rated continuous load. These tests/checks shall include but not limited to the tests as indicated below. The details of the tests are as indicated below: 1. Light Load Test This test is carried out to verify that the UPS is correctly connected and all functions operate properly. The load applied is limited to some percent of rated value. The following points should be checked: (a) Output voltage, frequency and the correct operation of meters; (b) Operation of all control switches and other means to put units into operation. (c) Functioning of protective and warning devices. (d) Operation of remote signaling and remote control devices. 2. Checking of Auxiliary Devices The functioning of auxiliary devices, such as lighting, cooling, pumps, fans, annunciation, etc., should be checked, if convenient, in conjunction with the preliminary light load test. 3. Synchronisation Test If possible, frequency variation limits should be tested by use of a variable frequency generator, otherwise, by simulation of control circuit conditions. If applicable the rate of change of frequency during synchronization shall be measured.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)	TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-05 POWER SUPPLY	PAGE 11 OF 14

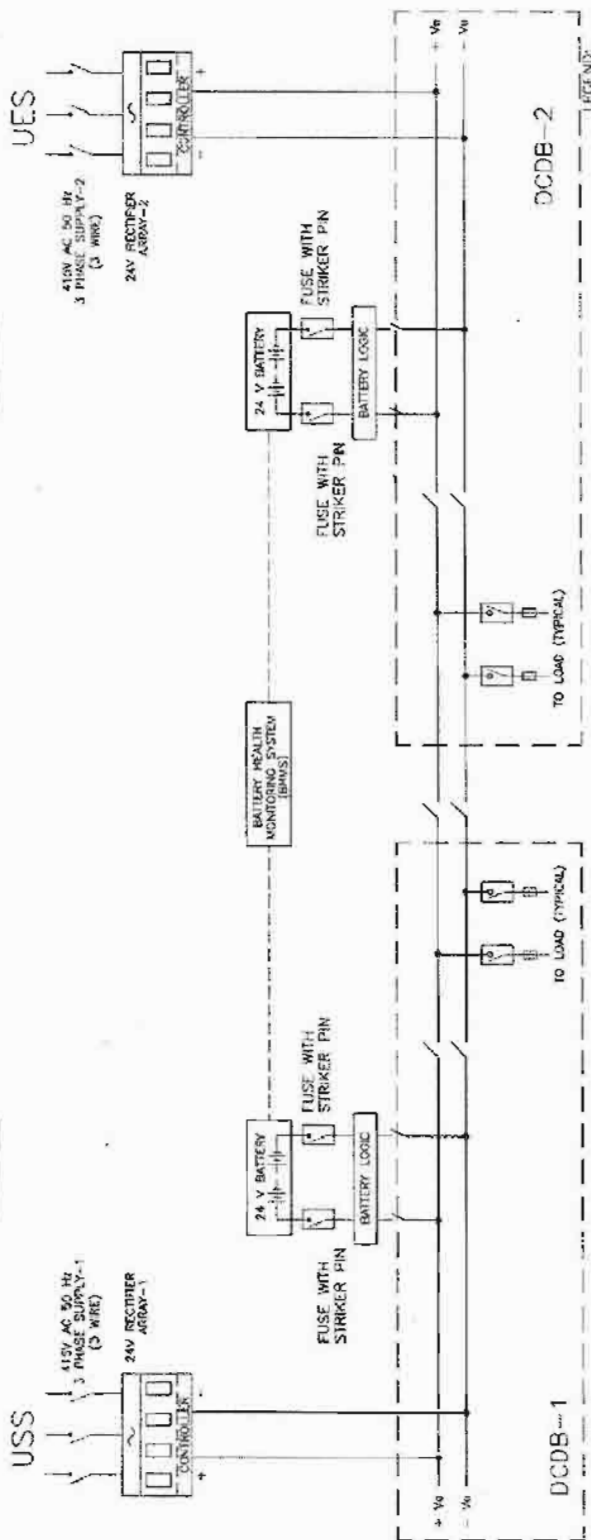
CLAUSE NO.	TECHNICAL REQUIREMENTS			
	4. A. C. Input Failure Test The test is performed with a fully charged battery and is carried out by tripping input circuit breakers or may be simulated by switching off all UPS rectifiers and bypass feeder as at the same time. Output voltage variations are to be checked for specified limits with an oscilloscope or equivalent. Frequency variation is defined as the steady state frequency of the UPS with and without AC input. The rate of change of frequency is measured by the time it takes to reach steady-state values. 5. A. C Input Return Test AC input return test is performed by closing AC input circuit breakers, or is simulated by energizing rectifiers and bypass feeders. Proper operation of rectifier starting and voltage and frequency variations are to be observed. Note: This test is normally performed with a fully of partially charged battery. 6. Simulation of Parallel Redundant UPS Fault This test is applicable for UPS with parallel redundant connections. Faults of rectifier or inverter units may be carried out by simulation. Output transients are to be observed. 7. Transfer Test This test is applicable for UPS with bypass, particularly in the case of an electronic bypass switch. Transients shall be measured during load transfer to bypass caused by a simulated fault and load retransfer after clearing of the fault. 8. Full load test Load tests are performed by connecting the actual load to the UPS output. Large UPS in parallel connection may be load tested by testing the individual UPS units separately. Load tests are necessary for testing output voltage and frequency, rated stored energy, recharge time, ventilation, temperature rise and determination of efficiency. Load tests are performed to prove transient voltage deviations specified under step load conditions. 9. Efficiency Efficiency should be determined by the measurement of the active power at input and output. 10. Actual Load Test Conditions under actual load may differ from those with a dummy load. Steady-state generation of current and voltage harmonics and transients at load switching conditions should be observed 11. Current Division in Parallel Load sharing between the Modular DC power supply rectifier banks & UPS units shall be measured with actual load under conditions of parallel operation. 12. Rated Stored Energy Time (Battery Test) This test is a load test to prove the actual possible time of battery operation.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIIC-05 POWER SUPPLY	PAGE 12 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	If rated load is not available in the case of large UPS, it is possible to apply a partial load to check the actual battery discharge characteristics and compare these with characteristics specified by the battery manufacturer. Discharge time with rated load shall then be calculated. The test shall be performed with a fully charged battery and also may be done under other battery conditions to be specified, if so agreed. Active power output of the UPS and the battery voltage shall be recorded during the test. Since new batteries often do not provide full capacity during a starting up period, the discharge test may be repeated after a reasonable recharge time if the original test has failed. 13. Rated Restored Energy Time Restored energy depends on the charging capacity of the rectifiers and the battery characteristics. If a certain recharging rate is specified, it shall be provided by repeating the discharge test after the specified charging period. 14. Battery Ripple Current If battery ripple currents are specified, then the ripple current which depends on UPS operation shall be checked under normal operating conditions. Rough measuring methods are sufficient. 15. On site Ventilation Test The test is performed with the actual load. Temperature conditions of all Modular DC power supply rectifiers & UPS cubicles are to be observed. 16. Overload Capability Test Overload capability test is a load test. Specified values of short time overload or starting up sequences of actual load are to be applied for the time interval specified. Specified values of voltage and current are to be recorded. 17. Short Circuit Current Capability If short-circuit current capability is specified, it may be tested by applicable of a short circuit to UPS output if necessary, via a suitable fuse, Short-circuit current is to be recorded. 18. Short Circuit Fuse Test Fuse tripping capability of a UPS shall be tested, by short-circuiting the UPS output via a fuse of specified type. The test shall be repeated to ensure against fuse non-uniformity and switching time during the cycle. The test is carried out at an appropriate UPS load, under normal operation, if not otherwise specified by Employer. 19. Restart Automatic or other restart means are to be tested after a completed shut-down as specified. 20. Output Over voltage Output over voltage protection is to be checked.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-05 POWER SUPPLY	PAGE 13 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	21. Periodic output voltage modulation When this test is specified, it may be checked by voltage recording at different loads and operating conditions. 22. Harmonic Components Harmonic components of output voltage shall be checked with the actual load. Methods of specification and checking shall be subject to Employer's approval. 23. Earth Fault Test If the DC Power Supply/ UPS output is isolated from earth, then an earth fault can be applied to any output terminal. DC Power Supply/ UPS output transients (if any) shall be measured. If the battery is isolated from earth, then an earth fault can be applied to any output terminals. DC Power Supply/ UPS output transient (if any) shall be measured. 11.02.00 24V DC Power Supply System The functional tests to be carried out for 24V DC Power Supply system shall be the same as specified under clause no. 11.01.01 above excepting the Sl. Nos. 2,3,6,7,17,18 and 22. 12.00.00 CONTRACT QUANTITIES Refer Appendix-I to part A, Section VI of technical specifications. 13.00.00 TRAINING Contractor shall provide training on UPS & 24V DC Power Supply system for Employer's personnel. The duration of the training shall be as elaborated in Part-C, Section-VI of technical specifications.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)	TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-05 POWER SUPPLY	PAGE 14 OF 14

SET-1

SET-2



TWO SET CONFIGURATION

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NTPC Limited
(A DIV. OF NDA GROUPS)
ENGINEERING DIVISION

TYPICAL THERMAL POWER PROJECT

SCHEME FOR 24 V DC POWER SUPPLY SYSTEM

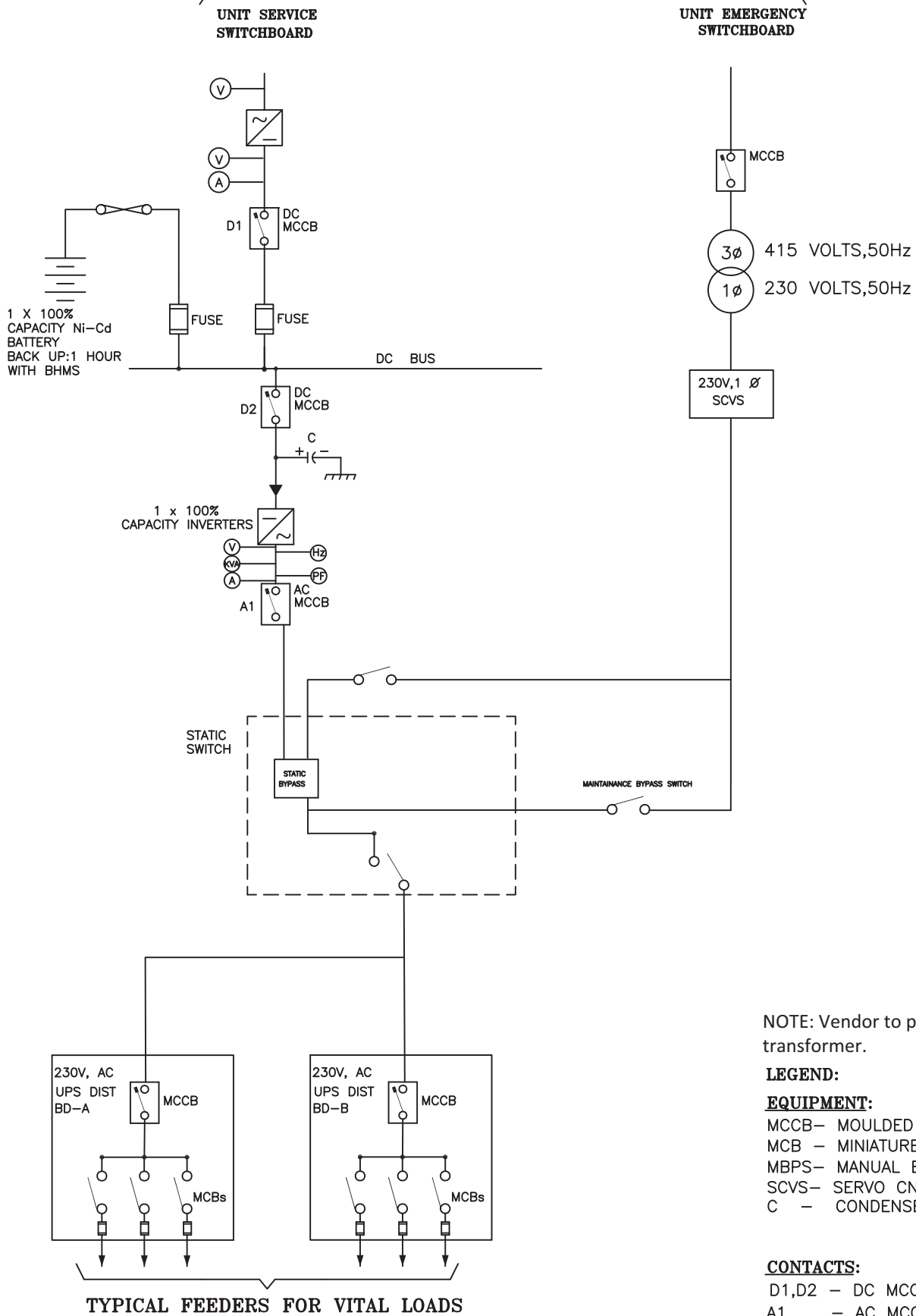
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A	27.08.17					
DESCRIPTION						

1. SUITABLE INTERLOCK SYSTEM SHALL BE PROVIDED IN FLOAT/BOOST CHARGING MODE.

NOTES:-

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415V 3PH 3 WIRE FEEDER



NOTE: Vendor to provide isolation transformer.

LEGEND:

EQUIPMENT:

MCCB— MOULDED CASE CKT BRKR
MCB — MINIATURE CIRCUIT BRKR
MBPS— MANUAL BYPASS SWITCH
SCVS— SERVO CNTRD VOL STBLR
C — CONDENSER

CONTACTS:

D1,D2 — DC MCCBs
A1 — AC MCCBs



PVUNL PATRATU TPP PHASE-1
EPC (3X800 MW)

TITLE:—

UPS SCHEME
FOR OFFSITE

DRG.
No.

PE-DG-434-145-I004

REV.
No.

00

DATE

06.01.2018

SHEET

3

OF

3

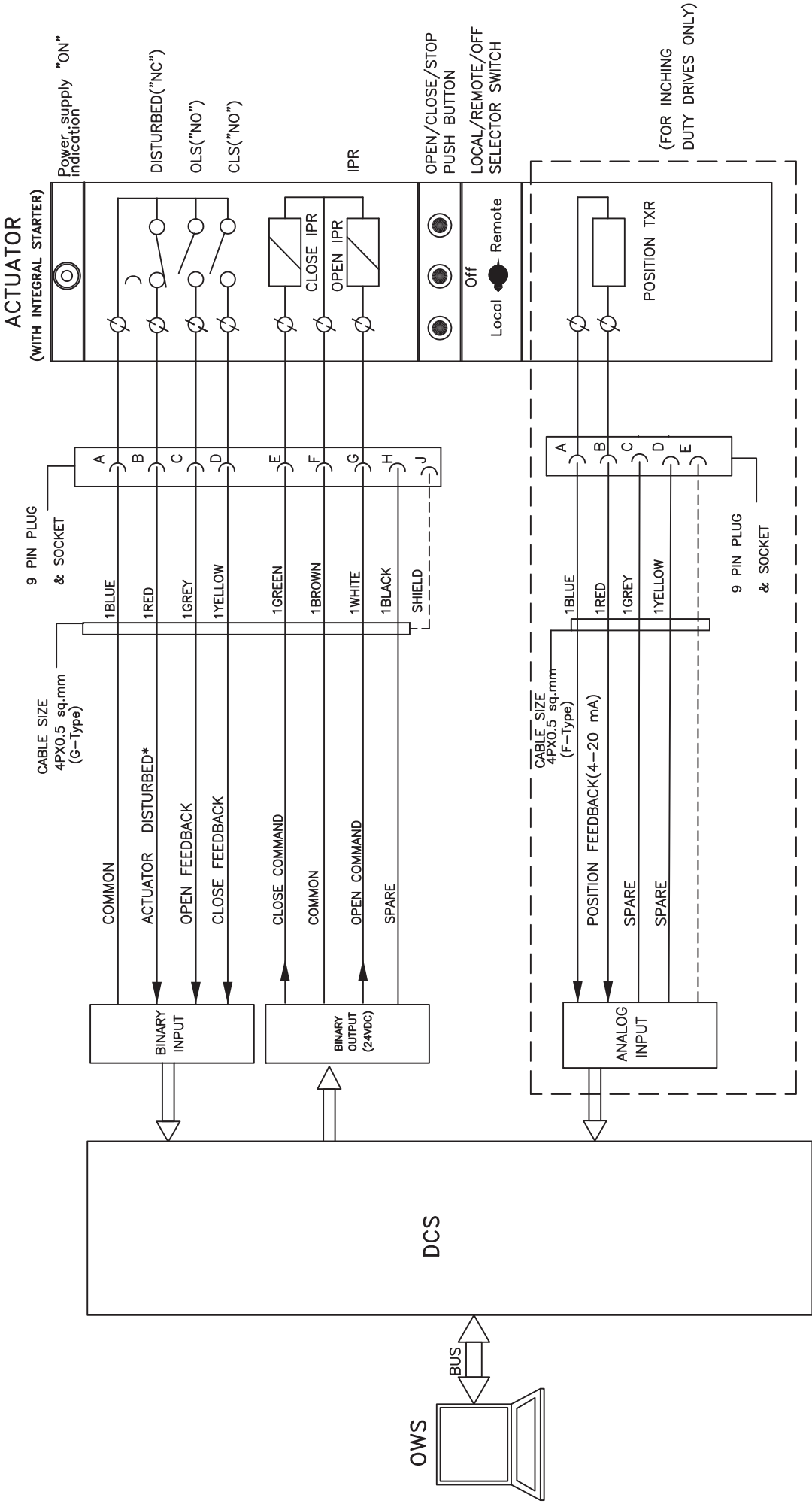


**C&I SPECIFICATION FOR
HYDROGEN GENERATION PLANT**

SECTION: C
SUB SECTION: C&I

**SIGNL EXCHANGE BETWEEN DRIVES &
DCS**

DCS INTERFACE FOR (BIDIRECTIONAL DRIVE WITH INTEGRAL STARTER) (BID/BIDI)

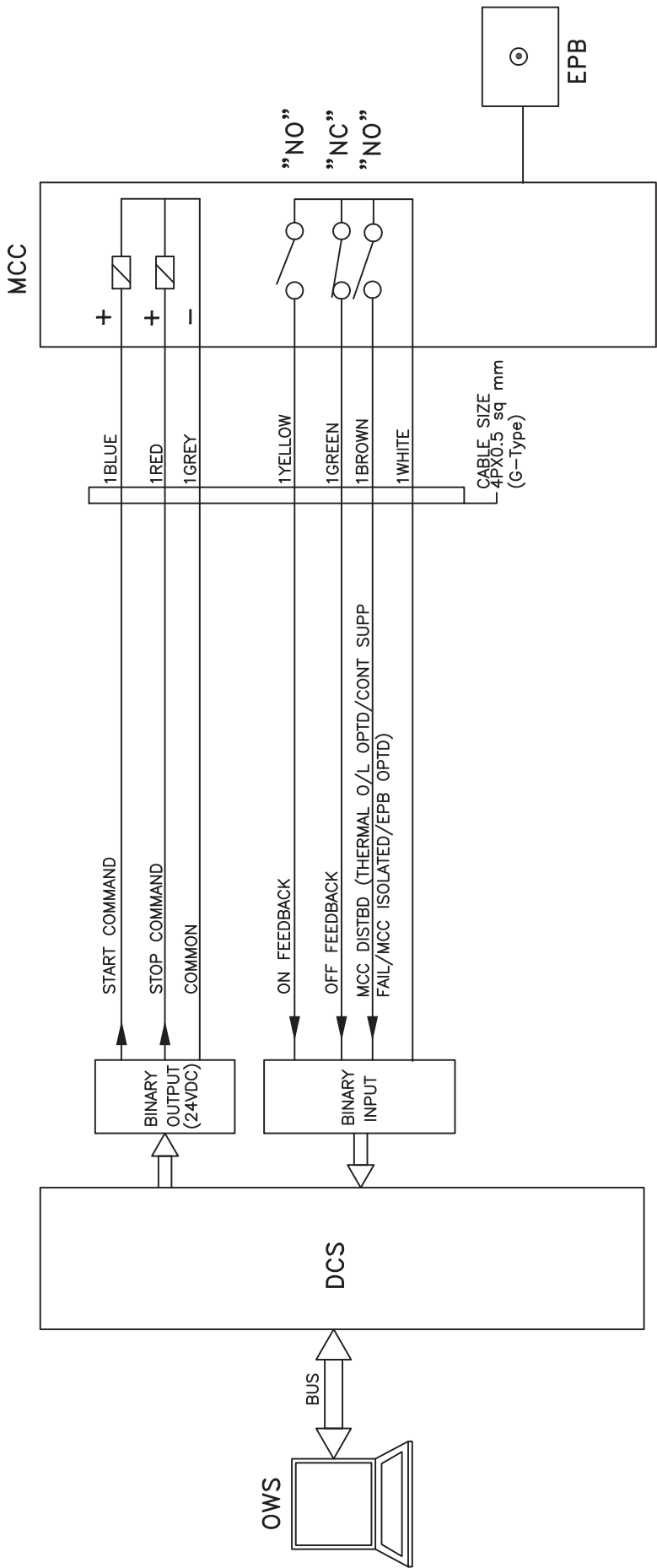


NOTE:

- * DISTURBED= Loss of Power supply (1 Phase/3 Phase)/
- Loss of control supply/ Motor thermostat trip/
- Thermal over load/
- Local/Off/Remote Sel. switch in local or off mode/

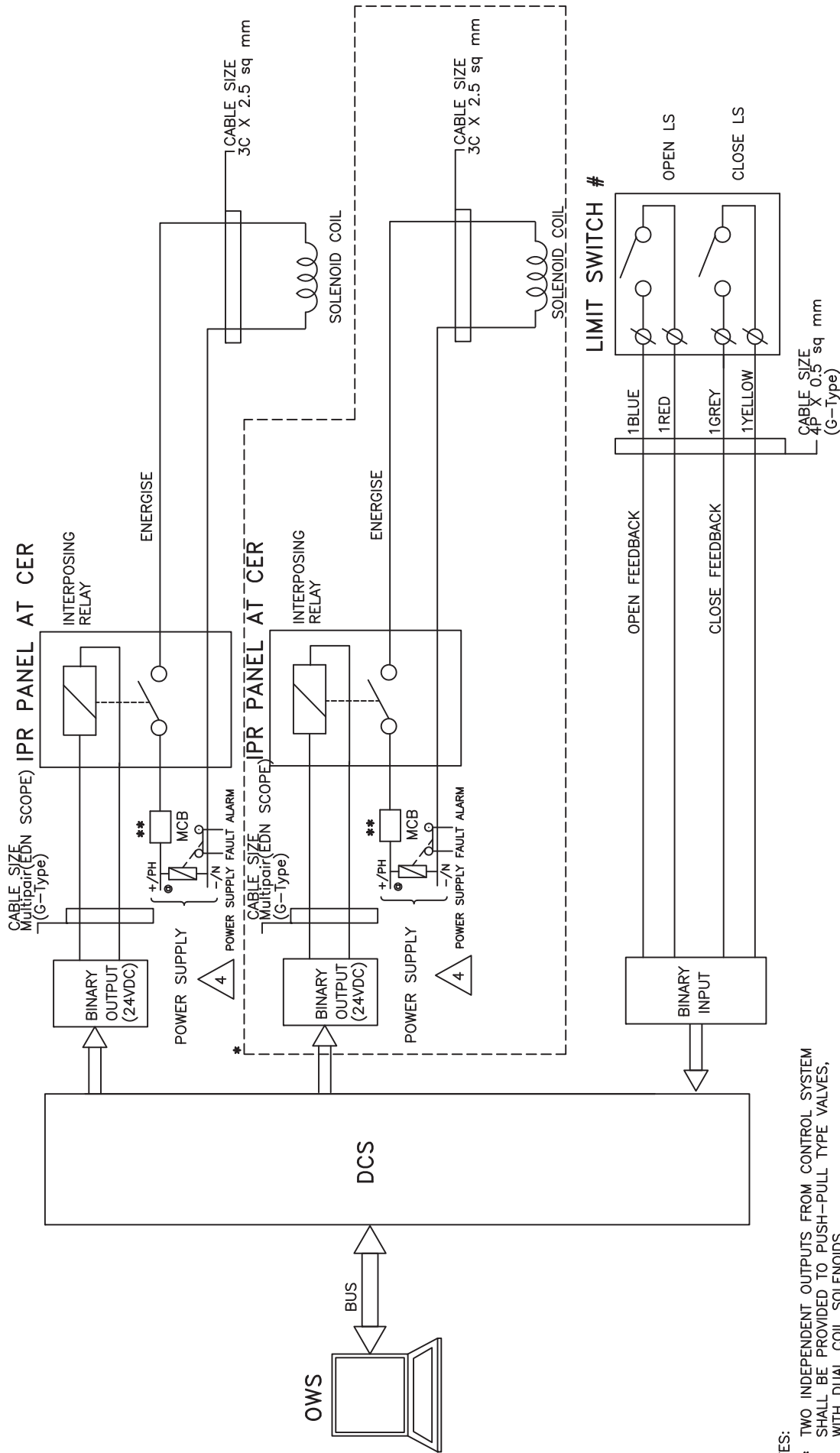
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			DATE	05.04.18	
			REV.NO.	00	
TITLE		DDCMIS INTERFACE FOR BIDIRECTIONAL DRIVE		SHT	7

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE (CONTACTOR CONTROLLED) (LTUD)



	PROJECT: PATRATU STPP		DRG.NO.	PE-DM-434-145-1002
	TITLE		DATE	05.04.18
DDCMIS INTERFACE FOR UNIDIRECTIONAL LT DRIVE		REV.NO.	00	
		SHT	08	OF 13

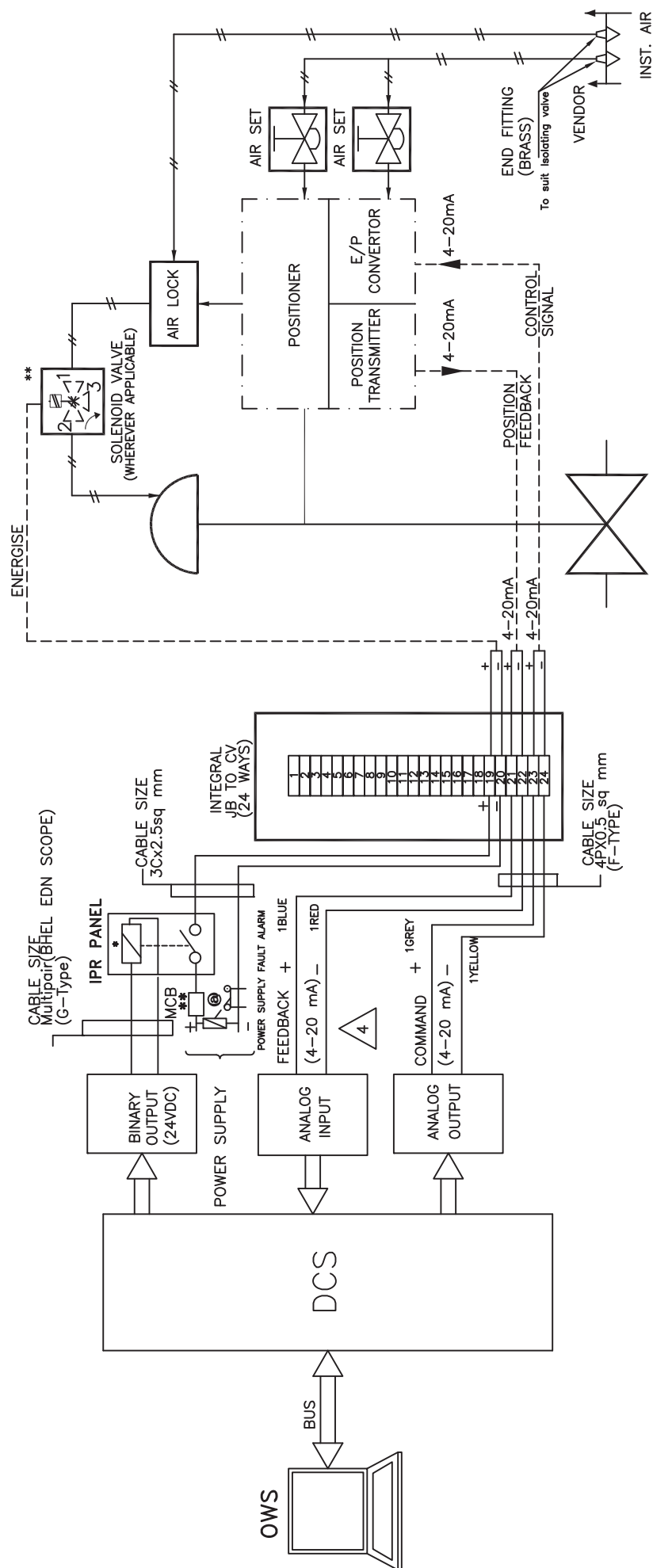
DCS INTERFACE FOR SOLENOID DRIVE (SOLV) (24V DC / 240V AC UPS)



- NOTES:
- * TWO INDEPENDENT OUTPUTS FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH-PULL TYPE VALVES, WITH DUAL COIL SOLENOIDS.
 - ** MCB SHALL BE PROVIDED FOR EACH SOLENOID
 - # FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.
 - © COMMON FOR ALL SOLENOID VALVES

PROJECT: PATRATU STPP	DRG.NO.	PE-DM-434-145-1002
	DATE	05.04.18
	REV.NO.	00
TITLE	DDCMIS INTERFACE FOR SOLENOID DRIVE	
	SHT	9

DCS INTERFACE FOR ANALOG DRIVE (MOD-P)

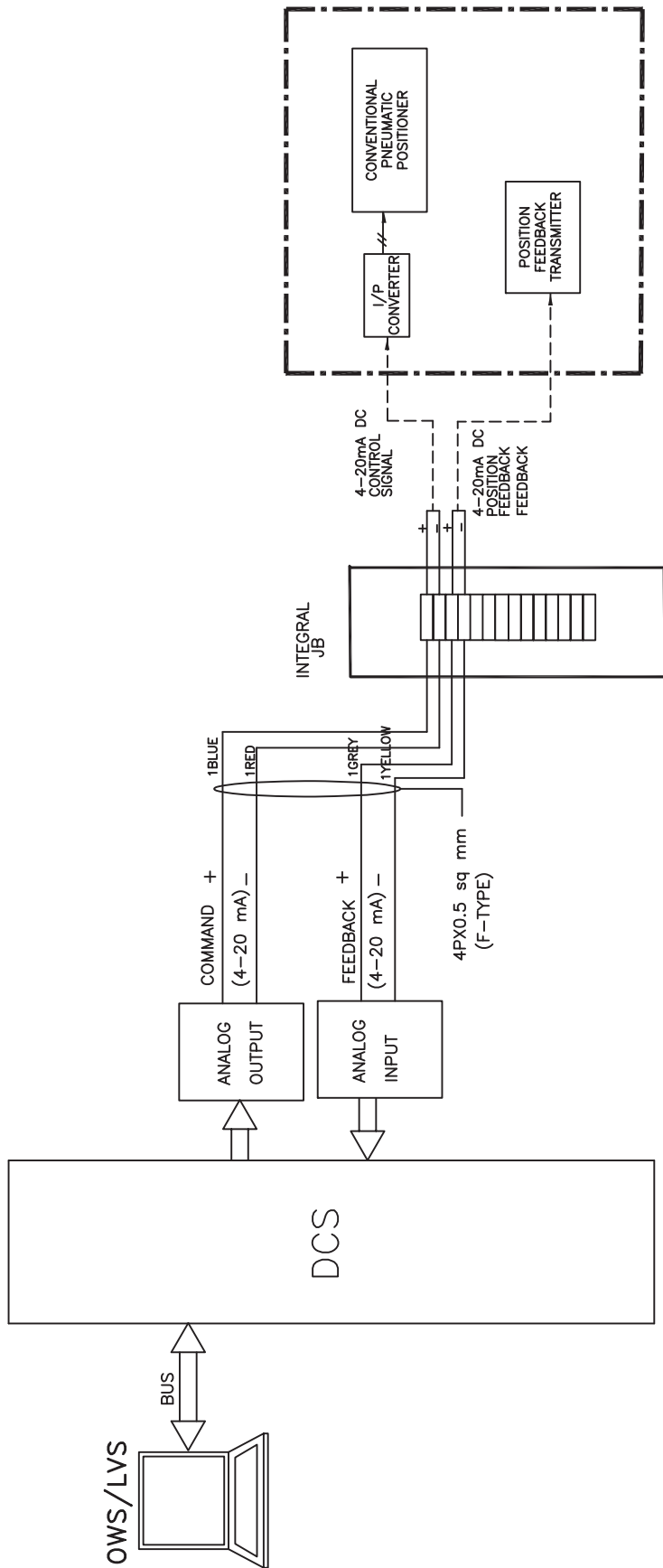


NOTES:

- * APPLICABLE TO VALVES WHERE PROTECTION OPEN/CLOSE ACTION FOR CONTROL DEMAND OVERRIDING IS REQUIRED.
- *** MCB SHALL BE PROVIDED FOR EACH SOLENOID
- © COMMON FOR ALL SOLENOIDS

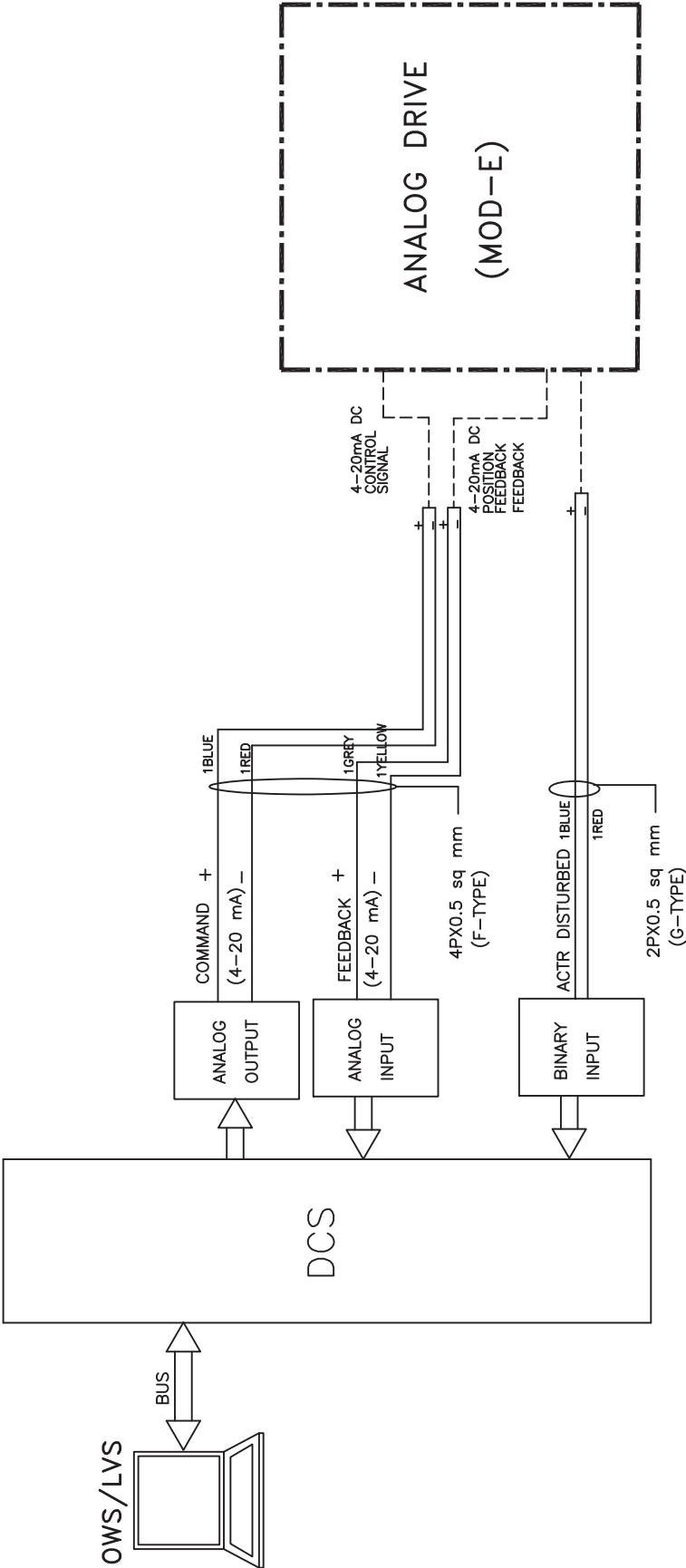
	PROJECT: PATRATU STPP		DRG.NO.	PE-DM-434-145-1002
	TITLE TYPICAL HOOK-UP DIAGRAM ANALOG DRIVE		DATE	05.04.18
			REV.NO.	00
			SHT	11

DCS INTERFACE FOR MODULATING TYPE PNEUMATIC DAMPER



	PROJECT: PATRATU STPP		DRG.NO.	PE-DM-434-145-1002
			DATE	05.04.18
TITLE DCS INTERFACE FOR MODULATING TYPE PNEUMATIC DAMPER		REV.NO.	00	
		SHT	12	

DCS INTERFACE FOR ANALOG DRIVE (MOD-E)



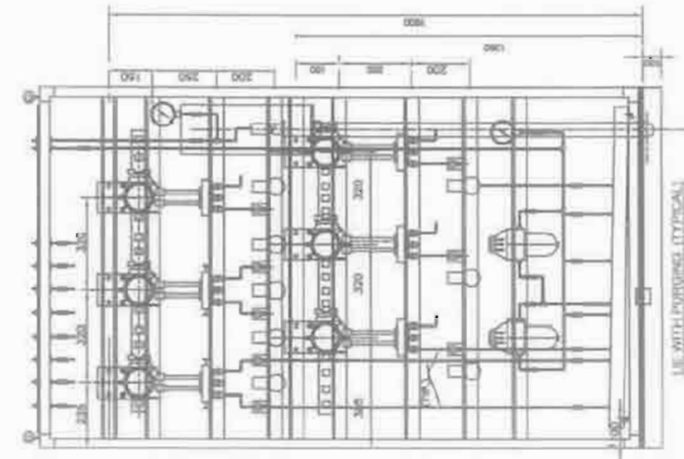
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TITLE DCS INTERFACE FOR ANALOG DRIVE		REV.NO.	00	
MODULATING ELECTRIC TYPE		SHT	13	



**C&I SPECIFICATION FOR
HYDROGEN GENERATION PLANT**

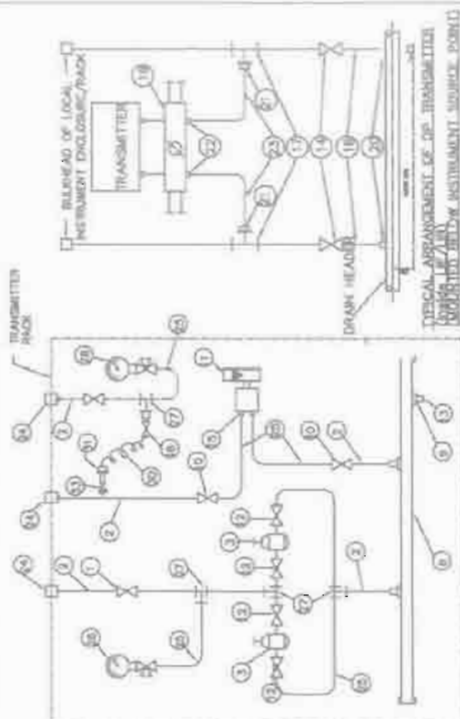
SECTION: C
SUB SECTION: C&I

**DRIVE & INSTRUMENT INTERFACE
DIAGRAM**



TMS	ITEM	DESCRIPTION
1.	ISOLATION VALVE (yellow/green)	SS.
2.	SEAMLESS BR PIPE	
3.	AIR FILTER REGULATOR	
4.	WET. AIR HEATER SS.	
5.	COMP. INTRINSIC VALVE SS.	
6.	AIR PURGE SET.	
7.	COMP. VALVE SS.	
8.	PLUG SS.	
9.	TUBE SS. CONNECTOR	
10.	TUBE CLAMP, EQUAL TEE UNIVERS.	
11.	BLANKHEAD SS. SUITABLE FOR 1/2 PIPE CONNECTION	
12.	SEAMLESS TUBE SS.	
13.	BRANCH TEE SS.	
14.	PL. GALIC.	
15.	NYLON FLEX. HOSE BRASSER WITH SS. WFL.	
16.	HOSE BARBED COAN. SS.	
17.	HOSE CONNECT SS. (PIRE) AIR CONNECTION TO	
18.	QUICK DISCONNECT SS. (PIRE) AIR CONNECTION TO	
19.	INSTRUMENT SOURCE (NO).	

LIST OF MATERIALS	
ITEM NO.	DESCRIPTION
14.	1/4" BW GLOBE VALVE
17	SW REGAL TEE
18.	S.S. NIPPLE
19	3" VALVE MANIFOLD
20.	SW HALF COUPLER CS
21.	PIPE W/ TUBE UNION
22.	SUITABLE ADAPTER
23.	50 TUBE



TYPICAL PURGE AIR CONNECTION INSIDE THE INLET ENCLOSURE APPLICABLE FOR MILL AIR & FUEL GAS SERVICE INSTRUMENTS REQUIRING PURGE AIR

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NTPC LIMITED
NATIONAL THERMAL POWER CORPORATION
A GOVERNMENT OF INDIA ENTERPRISE

TYPICAL THERMAL POWER PROJECT

KEY EPIC PACKAGE)

ASURE, PURGING SCHEME.

DIP TRANSMITTER

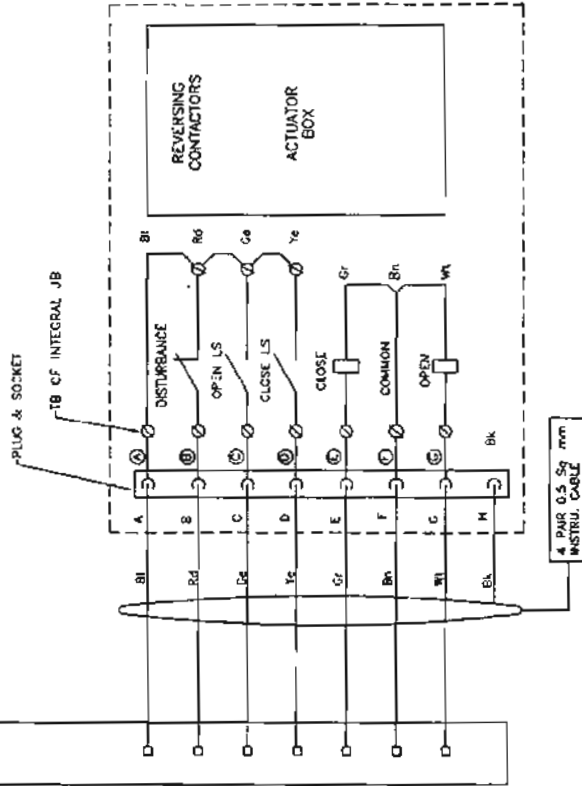
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TERMINATION AT
CONTROL SYSTEM END



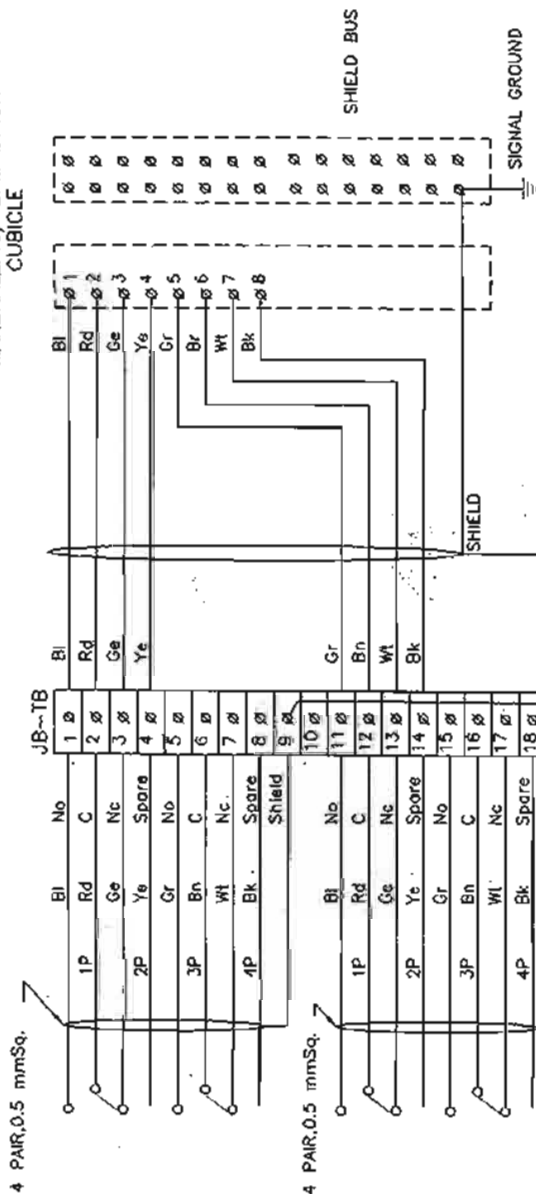
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महाराष्ट्र
NTPC

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ENGINEERING DIVISION

PROJECT		TYPICAL THERMAL POWER PROJECT	
TITLE		INTERFACING OF ACTUATORS	
REV. NO.	0000-999-POI-A-063	DRG. NO.	A
SCALE	N.T.S.	SIZE	A3
DATE		APPRO. DATE	
CHECKED BY		APPRO. DATE	
DESIGNED BY		APPRO. DATE	
DRAWN		APPRO. DATE	
CHECKED		APPRO. DATE	
DESCRIPTION			
REV. NO.	A	FIRST ISSUE	

MARSHALLING/TERMINATION CUBICLE



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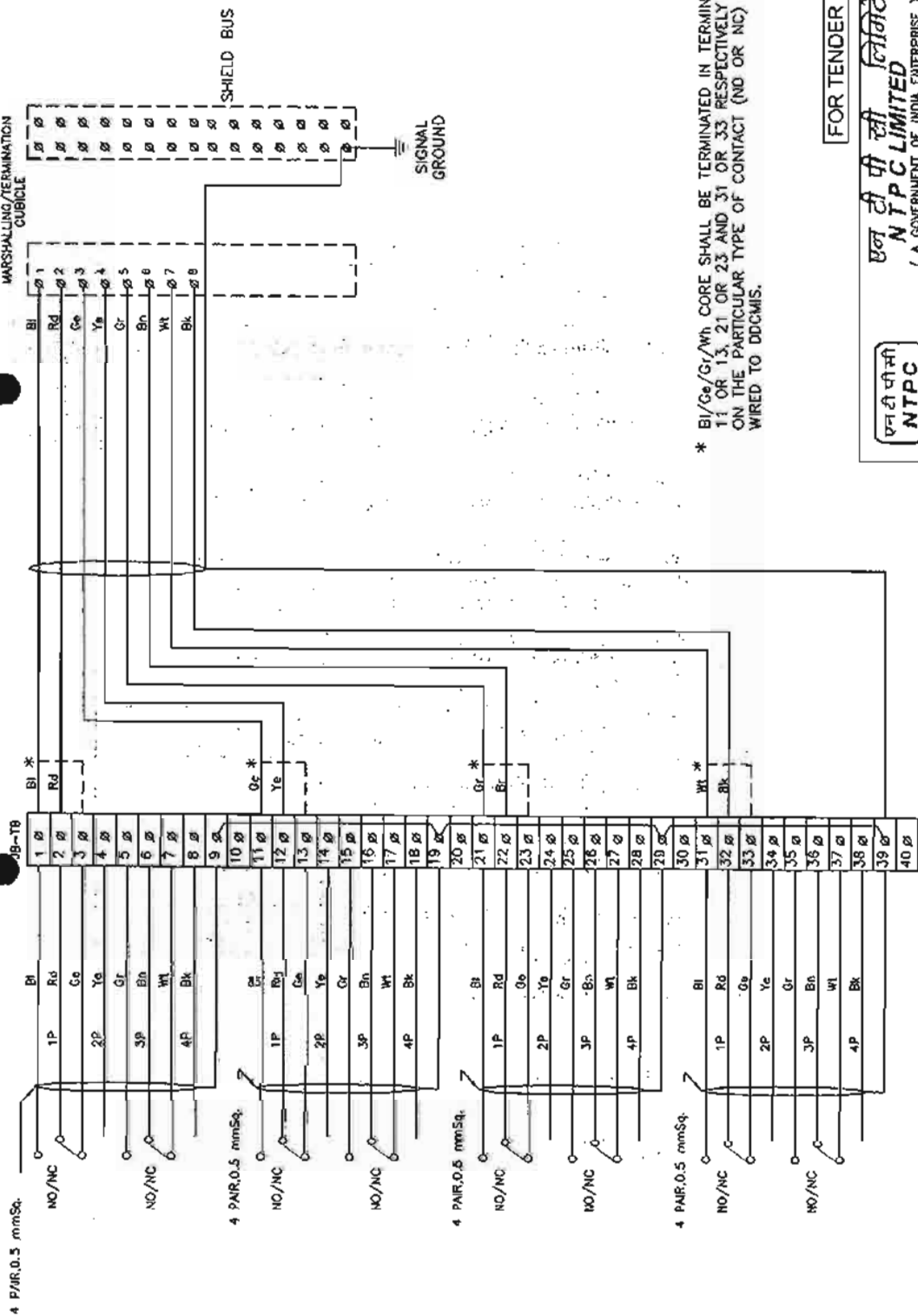
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NTPC

PROJECT
TYPICAL THERMAL POWER PROJECT

TITLE
INTERFACING OF FIELD INSTRUMENTS/
SWGR SWITCH (COC) TERMINATION DETAILS

REV. NO.	REV. NO.
A	A
SCALE	DRG. NO.
NTS	0000-999-POI-A-065
SIZE	SH 01 OF 14
A3	

DATE	20/04/08
APPRO	
ARCH	
C	
E	
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CHECKED	
DRAWN	
DESCRIPTION	
REV. NO.	
A	



* BI/Ce/Gr/Wt CORE SHALL BE TERMINATED IN TERMINAL 1 OR 3, 11 OR 13, 21 OR 23 AND 31 OR 33 RESPECTIVELY DEPENDING ON THE PARTICULAR TYPE OF CONTACT (NO OR NC) IS TO BE WIRED TO DDCMIS.

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 ENGINEERING DIVISION

PROJECT TYPICAL THERMAL POWER PROJECT

TITLE INTERFACING OF FIELD INSTRUMENTS
 SWITCH TERMINATION DETAILS
 NO/NC

REV. NO.	DRG. NO.	SCALE	SIZE	DATE	APPR.	ARCH.	CAT.	C	E	M	CHECKED	DESIGN	DESCRIPTION	REV. NO.
A	0000-999-POI-A-065	NTS	A3	20.04.08										A

SH 02 OF 14

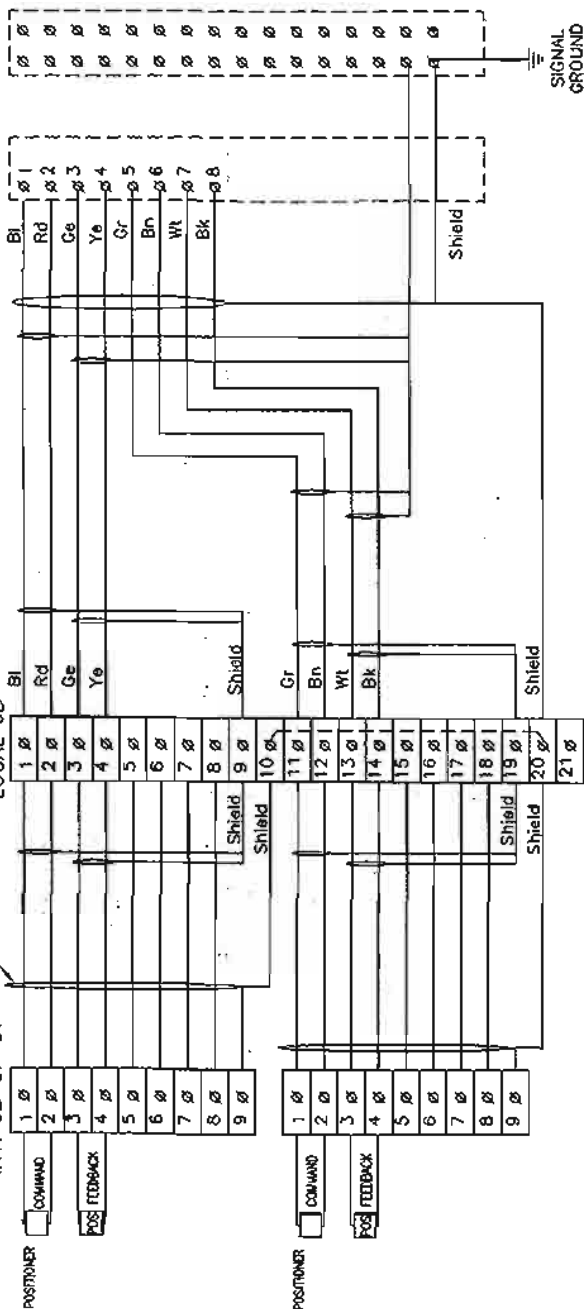
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MARSHALLING/TERMINATION
CUBICLE

4 PAIR, 0.5 mmSq.

INT. JB OF CV

LOCAL JB



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PROJECT
TYPICAL THERMAL POWER PROJECT

TITLE
INTERFACING OF FIELD INSTRUMENTS
CONTROL VALVE

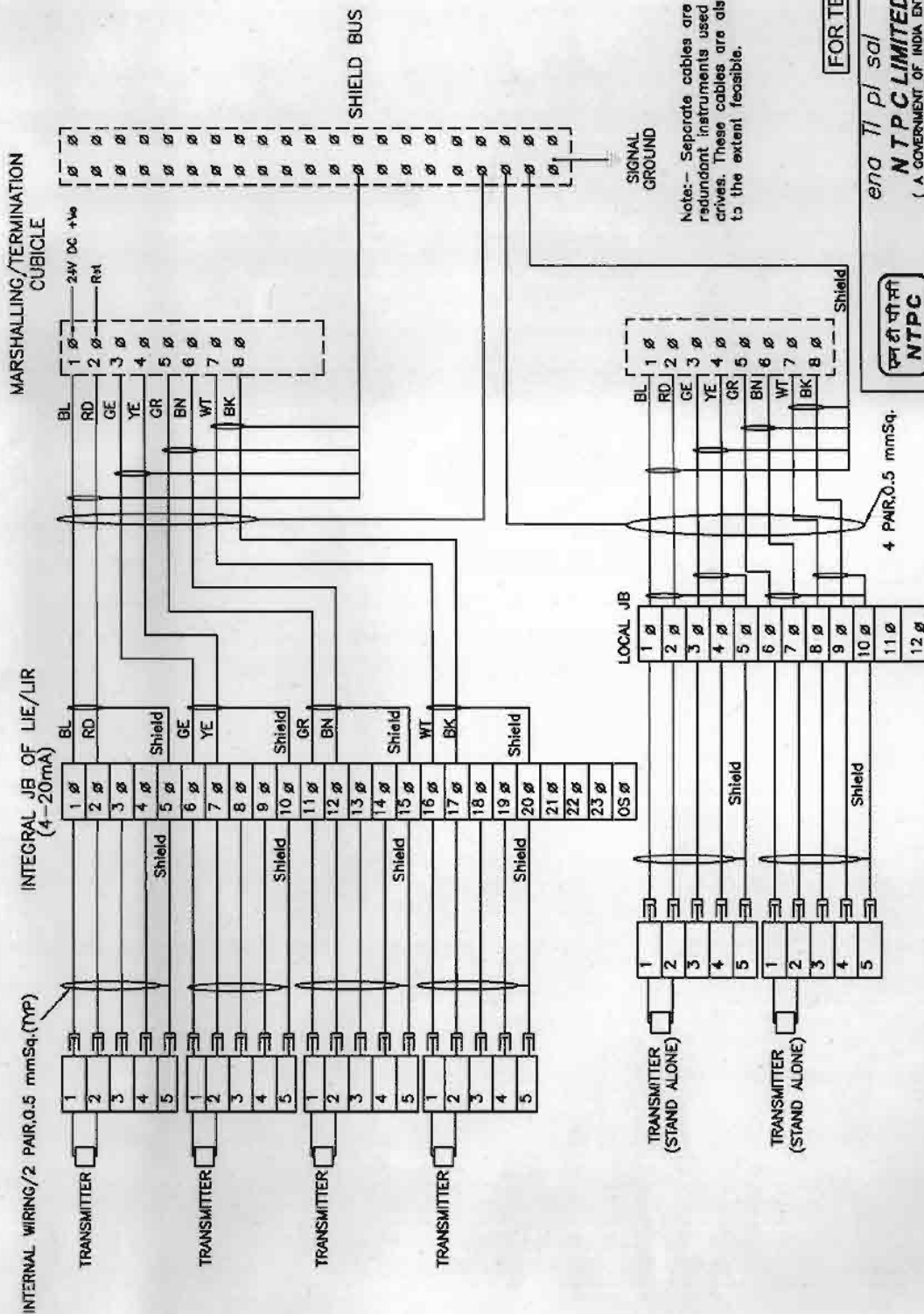
REV. NO.	DRG. NO.	SCALE	SIZE
A	0000-999-POI-A-065	NTS	A3

SH 03 OF 14

DATE	APPROVED	ARCH.	CHECKED	CLEAR BY
29.04.08				

DESIGNER
DRAWN
CHECKED

REV. NO.	DESCRIPTION
A	FIRST ISSUE

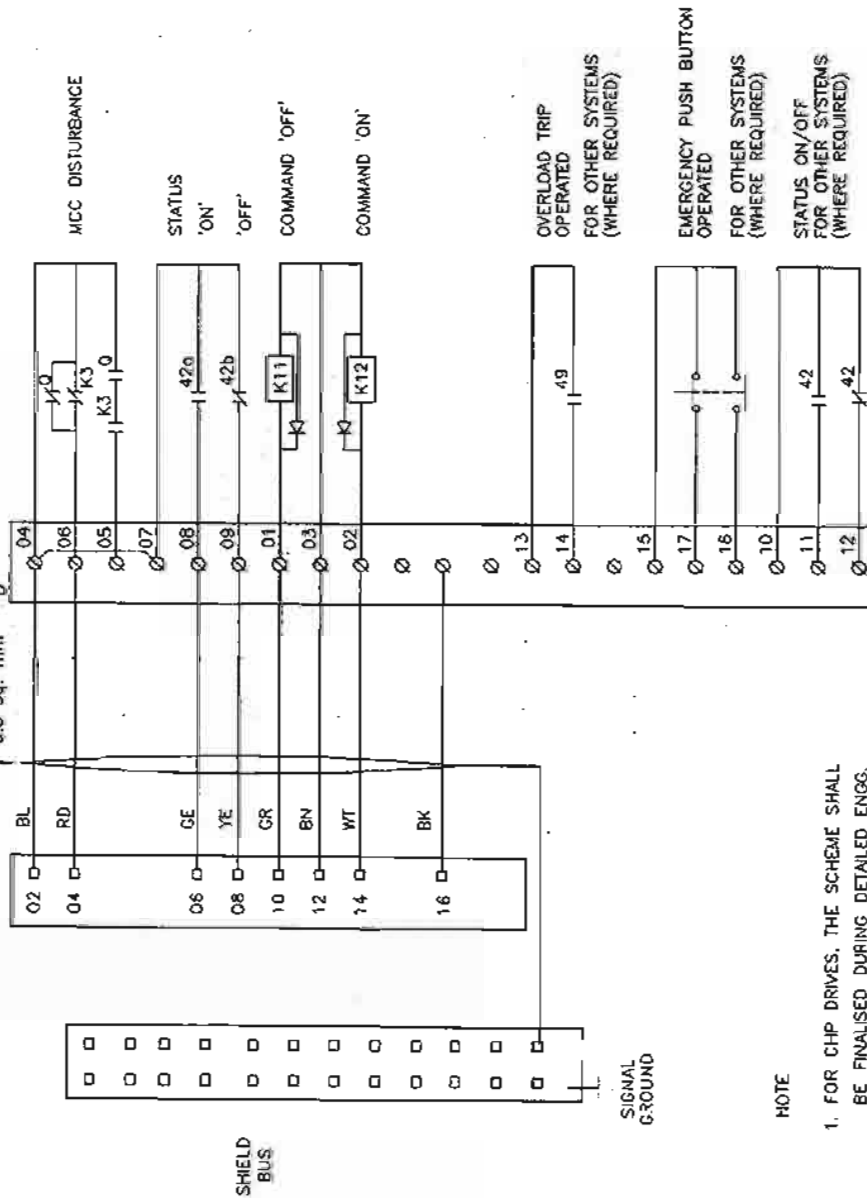


FOR TENDER PURPOSE ONLY

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NTPC LIMITED
 (A GOVERNMENT OF INDIA ENTERPRISE)
 ENGINEERING DIVISION

C	NOTE REGARDING CABLE IS ADDED.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															

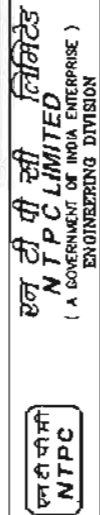
MARSHALLING/ TERMINATION CUBICLES 4 PAIR. 0.5 Sq. mm MCC/SWGR



NOTE

1. FOR CHP DRIVES, THE SCHEME SHALL BE FINALISED DURING DETAILED ENGG.

FOR TENDER PURPOSE ONLY



		TYPICAL THERMAL POWER PROJECT										PROJECT											
		INTERFACING OF FIELD INSTRUMENTS INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR (LT MOTORS)												TITLE									
												20.04.06		DATE		SIZE		SCALE		DRG. NO.		REV. NO.	
																A3		NTS		0000-999-POI-A-065		A	
																						SH 05 OF 14	

JUNCTION BOX FOR MOUNTING TEMP TX.

MARSHALLING/TERMINATION CUBICLE

SIGNAL GROUND

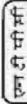
NOTE : 1) ABOVE IS THE TYP. ORG. FOR DIN RAIL MOUNTED TEMP TRANSMITTERS FOR RTD APPLICATION. EXACT TYPE OF TEMP TRANSMITTER SHALL BE AS PER PART-A OF SPECIFICATION.

2) THE EXACT GROUPING OF TEMP TXs SHALL BE FINALISED DURING DETAILED ENGG. STAGE.

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ENGINEERING DIVISION

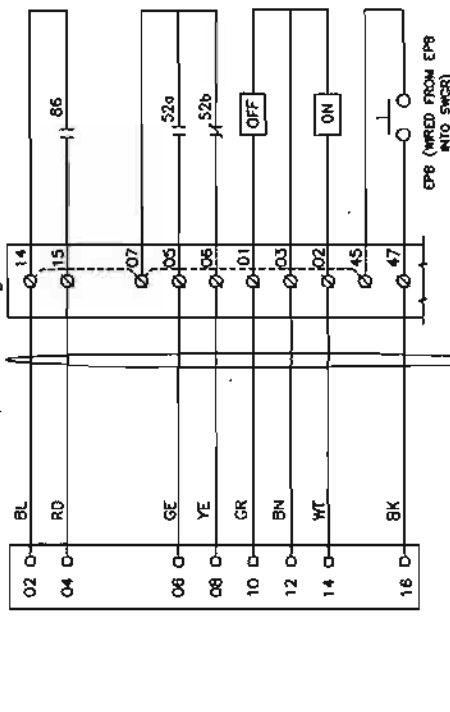
PROJECT		TITLE	
TYPICAL THERMAL POWER PROJECT		INTERFACING OF FIELD INSTRUMENTS TYPICAL RTD CONNECTION WITH TEMP TRANSMITTERS IN JBS	
REV. NO.	REV. NO.	SCALE	DRG. NO.
A	C	A3	0000-999-POI-A-065
DESCRIPTION		SH. 06 OF 14	

		NTPC LIMITED (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION		TYPICAL THERMAL POWER PROJECT	
PROJECT		TITLE			
		INTERFACING OF FIELD INSTRUMENTS TYPICAL RTD CONNECTION WITH TEMP TRANSMITTERS IN JBJS			
SIZE	SCALE	DRG. NO.	REV. NO.		
A3	NTS		0000-999-POI-A-065	C	SH 06 OF 14

PROJECT		ENGINEERING DIVISION	
TYPICAL THERMAL POWER PROJECT			
TITLE			
INTERFACING OF FIELD INSTRUMENTS			
TYPICAL RTD CONNECTION WITH TEMP TRANSMITTERS IN JBS			
SIZE	SCALE	DWG. NO.	REV. NO.
A3	NTS	0000-999-POL-A-065	C
		SH 06 OF 14	



MARSH./TERM CUBICLE 4 PAIR 0.5 Sq. mm MCC/SWGR



SHIELD BUS



SIGNAL GROUND

NOTE:-

1. SPARE CORES AT MCC/SWGR END ARE TO BE TERMINATED AT SPARE TERMINALS.
2. OVERLOAD ALARM & RELAY FAULT ALONG WITH OTHER INFORMATION SHALL FLOW THROUGH SOFT LINK.

FOR TENDER PURPOSE ONLY

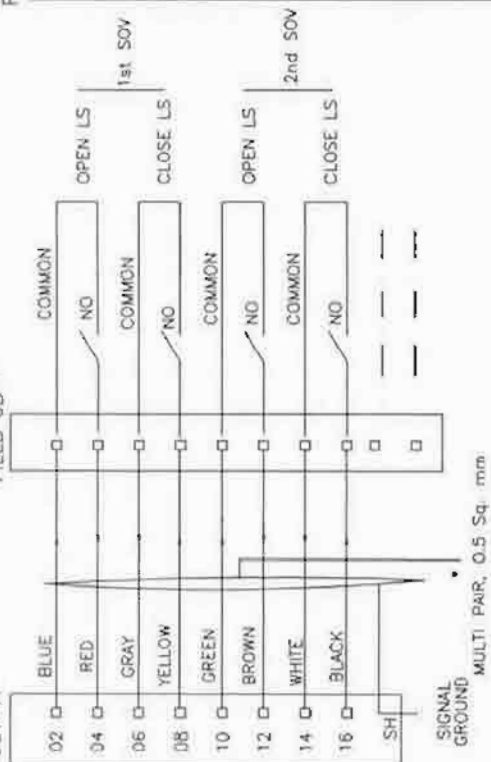
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ENGINEERING DIVISION

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NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT		TYPICAL THERMAL POWER PROJECT	
TITLE		INTERFACING OF FIELD INSTRUMENTS INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR (HT MOTORS)	
REV. NO.	DESCRIPTION	DATE	BY
B	Revised for Numerical relay based SWGR	11/02/08	11/02/08
REV. NO.	DESCRIPTION	DATE	BY
B	0000-999-POI-A-065	SH 07 OF 14	B

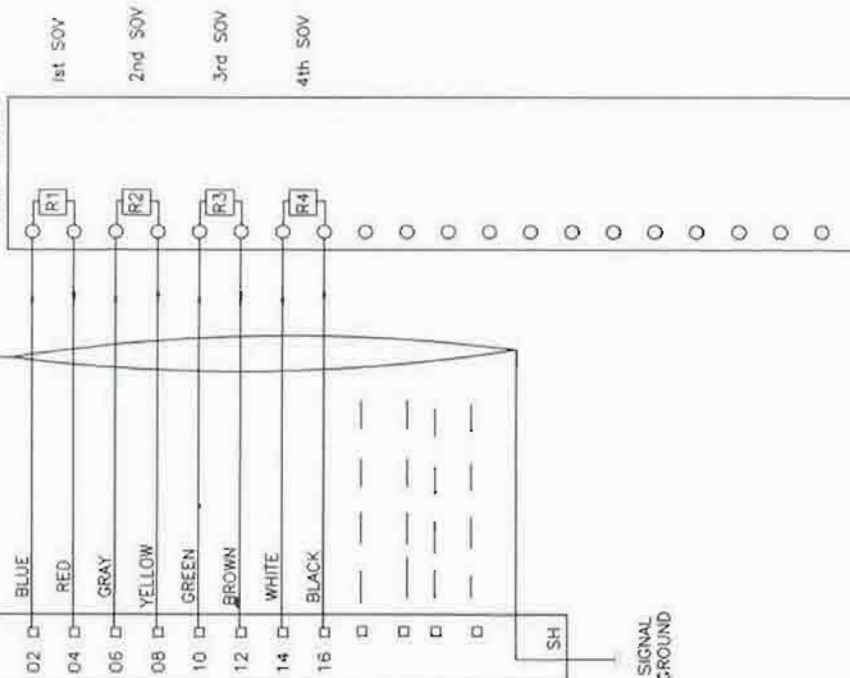
Marshalling/ Termination Cubicle
POST-A

FIELD JB



•• MULTI PAIR, 0.5 Sq. mm

RELAY PANEL



- 1) • FEEDBACKS OF SOVs CAN BE GROUPED IN FIELD JB AND MULTI PAIR CABLE IS TO BE USED FROM FIELD JB TO MARSHALLING/TERMINATION CUBICLE FOR FEEDBACKS OF GROUP OF SOVs. TYP-ARRANGEMENT IS SHOWN FOR A GROUP OF TWO SOVs WITH OPEN AND CLOSE LIMIT SWITCHES.
- 2) NO. OF LIMIT SWITCHES/NO. OF CONTACT IN LIMIT SWITCHES SHALL BE PROVIDED FOR EACH VALVE AS PER SPEC. REQUIREMENT/ PHILOSOPHY FOR RESPECTIVE SYSTEM.
- 3) •• MULTIPAIR CABLE IS TO BE USED FOR CONNECTION OF COMMAND OUTPUTS FROM MARSHALLING/TERMINATION CUBICLE TO RELAY PANEL FOR A GROUP OF SOVs.

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NTPC

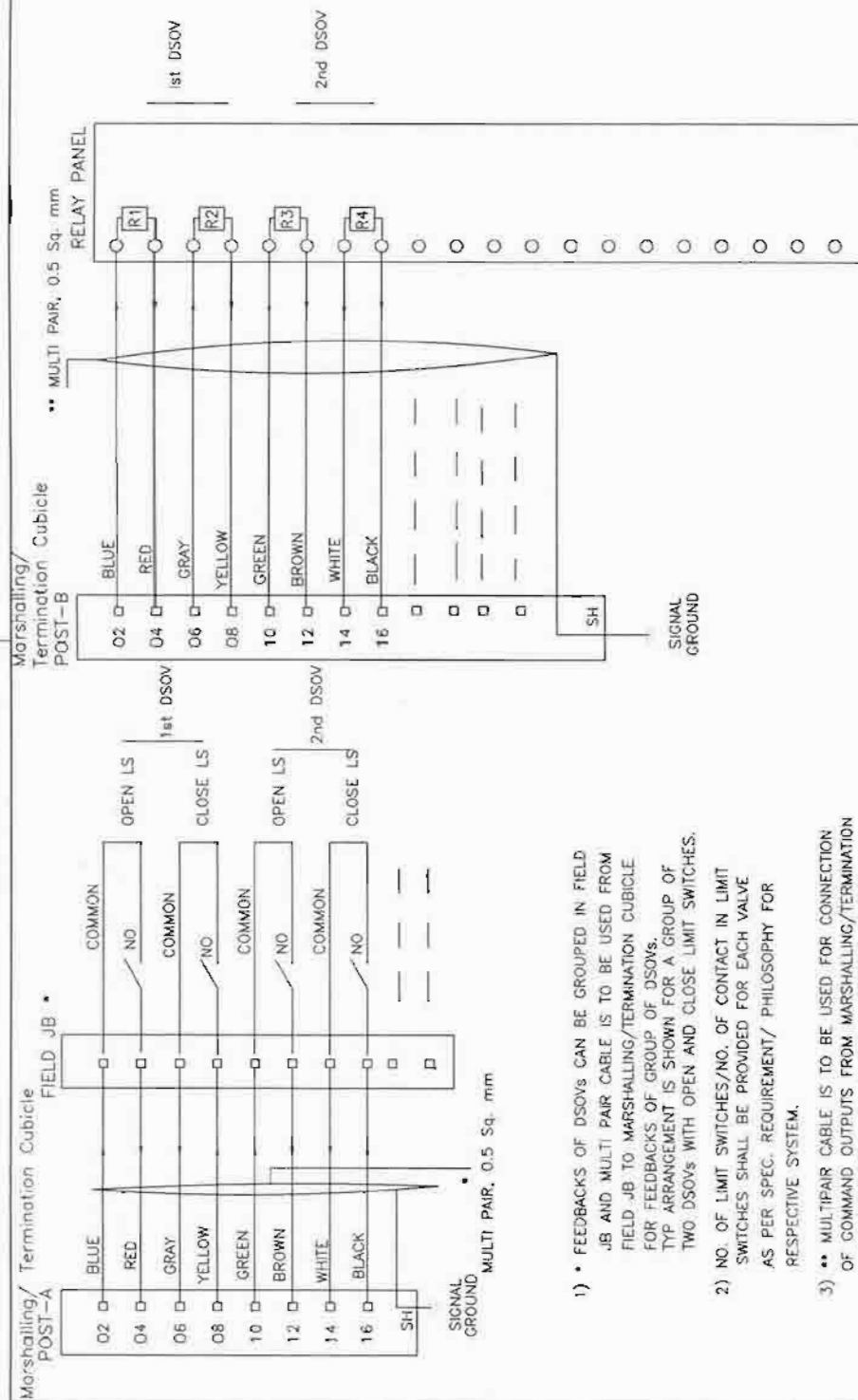
नेशनल थर्मल पावर कॉर्पोरेशन लिमिटेड
National Thermal Power Corporation Ltd.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT TYPICAL THERMAL POWER PROJECT

TITLE INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR
(SINGLE COIL SOLENOID)

SIZE A3 SCALE NTS
REV. NO. C
SH 08 OF 14

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	APPRO.	DATE	ASCH.	CAD	C	E	C	APPRO.	DATE	SCALE	SIZE	NTS	0000-999-POI-A-065	SH 08 OF 14	REV. NO.	C
B	FIRST ISSUE					30/10/22														



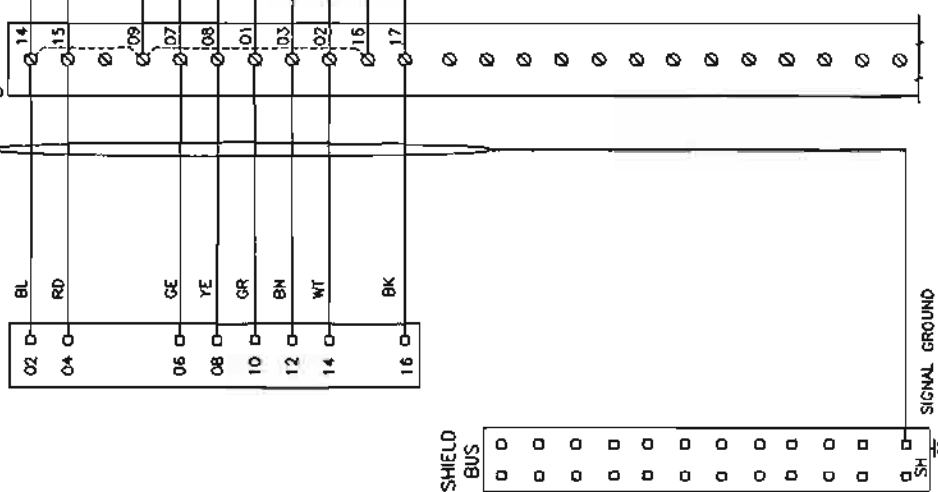
- 1) * FEEDBACKS OF DSOVS CAN BE GROUPED IN FIELD JB AND MULTI PAIR CABLE IS TO BE USED FROM FIELD JB TO MARSHALLING/TERMINATION CUBICLE FOR FEEDBACKS OF GROUP OF DSOVs.
- 2) NO. OF LIMIT SWITCHES/NO. OF CONTACT IN LIMIT SWITCHES SHALL BE PROVIDED FOR EACH VALVE AS PER SPEC. REQUIREMENT/ PHILOSOPHY FOR RESPECTIVE SYSTEM.
- 3) ** MULTIPAIR CABLE IS TO BE USED FOR CONNECTION OF COMMAND OUTPUTS FROM MARSHALLING/TERMINATION CUBICLE TO RELAY PANEL FOR A GROUP OF DSOVs.

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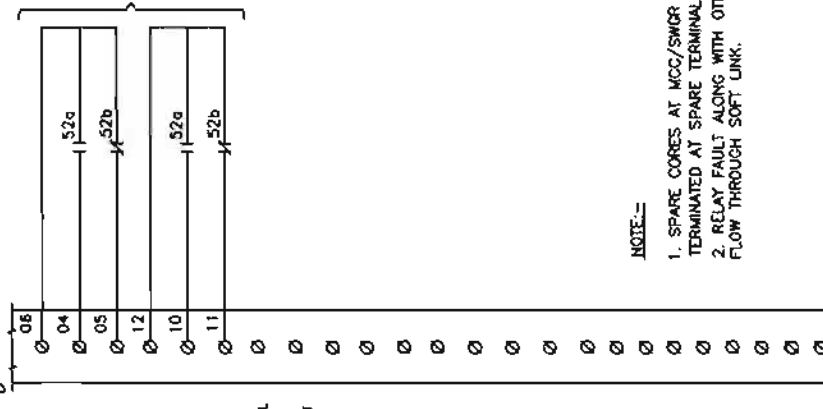
एन टी पी सी NTPC नेशनल थर्मल पावर कॉर्पोरेशन लिमिटेड National Thermal Power Corporation Ltd. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION									
PROJECT TYPICAL THERMAL POWER PROJECT TITLE INTERFACING OF FIELD INSTRUMENTS INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR (DOUBLE COIL SOLENOID) REV. NO. C									
SIZE A3 SCALE NTS DRG. NO. 0000-999-POI-A-065 SH. OF. OF 14									
DATE 06.10.02 APPRO. ARCH. CLEARED BY									
DESIGN CHKD. W E C CM									
DRAWN DESIGN CHKD.									
FIRST ISSUE									
REV. NO.									
DESCRIPTION									

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MARSHALLING/
TERMINATION CUBICLE 4 PAIR
0.5 Sq. mm



MCC/SWGR
D-

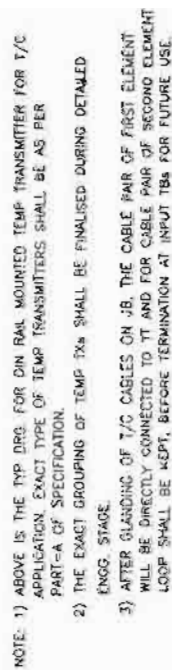


NOTE:-

1. SPARE CORES AT MCC/SWGR END ARE TO BE TERMINATED AT SPARE TERMINALS.
2. RELAY FAULT ALONG WITH OTHER INFORMATION SHALL FLOW THROUGH SOFT LINK.

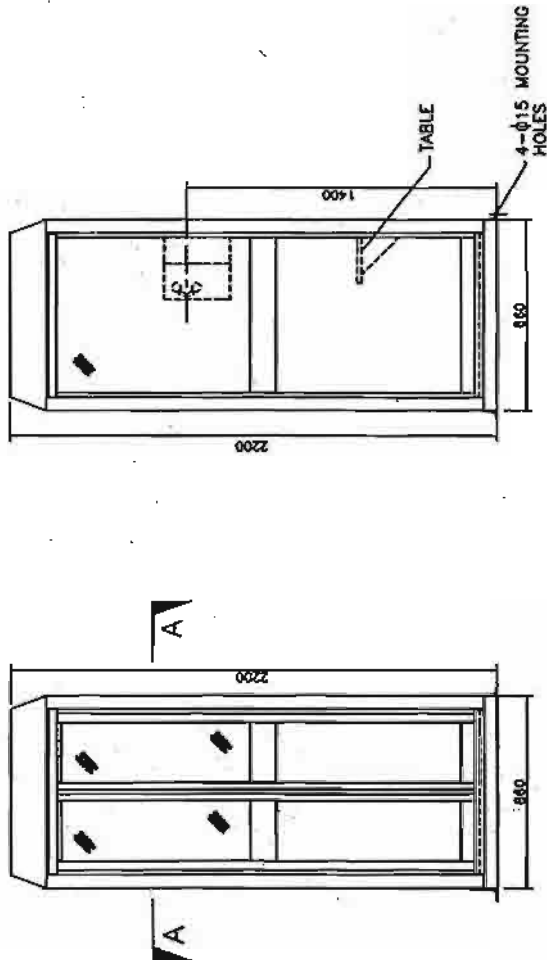
FOR TENDER PURPOSE ONLY

		एन टी सी लिमिटेड NTPC LIMITED (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION	
PROJECT			
TYPICAL THERMAL POWER PROJECT			
TITLE			
INTERFACE OF FIELD INSTRUMENTS (Elect. Bkr. - Sync.-LT)			
REV. NO.	SCALE	DRG. NO.	REV. NO.
8	NTS	0000-405-POI-A-065	8
DESCRIPTION		SH 10 OF 14	
Referred for Numerical Relay based SWGR. DRAWING DESIGN CHKD.		DATE 14.02.04 APPD.	
CLEARED BY M E C		C&I ARCH.	

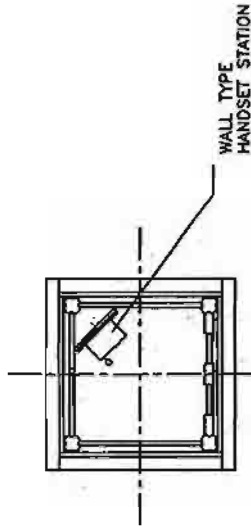


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NTPC
A GOVERNMENT OF INDIA ENTERPRISE
ENGINEERING DIVISION

ENGINEERING DIVISION														
TYPICAL THERMAL POWER PROJECT														
INTERFACING OF FIELD INSTRUMENTS TYPICAL T/C CONNECTION WITH TEMP TXs IN JES														
TITLE														
20/04/06														
DATE														
APPR														
ARCH														
C&I														
C														
E														
M														
Cleared By														
CHKD														
DESIGN														
DRAWN														
REV NO.														
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C														
SH 11 OF 14														
0000-999-P01-A-065														
BDRG. NO.														
SCALE														
NTS														
SIZE														
A3														
PROJECT														
FIRST ISSUE														
DESCRIPTION														
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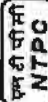
SECTION A-A



NOTES

1. LOCATIONS SHALL BE FINALISED DURING DETAILED ENGINEERING.

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		एन टी पी सी लिमिटेड NTPC LIMITED (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION	
PROJECT		TYPICAL THERMAL POWER PROJECT	
TITLE		ACOUSTIC HOOD OUT LINE	
REV. NO.	A	SCALE	N.T.S.
SIZE	A3	DRG. NO.	0000-999-POI-A-070
DATE	26/04/06	APPD	
CHKD.		ARCH.	
DESIGN		C&I	
CHECKED		C	
APPROVED		M	
DESCRIPTION		CLEARED BY	
FIRST ISSUE			
DRAWN			



**C&I SPECIFICATION FOR
HYDROGEN GENERATION PLANT**

SECTION: C
SUB SECTION: C&I

**INSTRUMENTATION CABLE
INTERCONNECTION AND TERMINATION
PHILOSOPHY**

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC																																																	
3.07.00																																																						
4.00.00																																																						
5.00.00																																																						
	INSTRUMENTATION CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY 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. TABLE A: CABLE TERMINATION TO BE FOLLOWED <table><tr><th colspan="2">Application</th><th colspan="2">Type Of Termination</th><th rowspan="2">Type Of Cable</th></tr><tr><th>FROM (A)</th><th>TO (B)</th><th>END A</th><th>END B</th></tr><tr><td>Valves/dampers drives (Integral Junction box)</td><td>Marshalling / Marshalling – cum Termination Cubicle / local group JB</td><td>Plug in connector</td><td>Post mount cage clamp type.</td><td>G</td></tr><tr><td>Transmitters, Process Actuated switches mounted in LIE/LIR</td><td>Integral Junction box of LIE/LIR</td><td>Plug in connector</td><td>Cage clamp (Rail mount) type.</td><td>F,G</td></tr><tr><td>RTD heads</td><td>Local junction box</td><td>Plug in connector</td><td>Cage clamp (Rail mount) type.</td><td>F</td></tr><tr><td>Thermocouple</td><td>Local junction box / CJC box (if applicable)</td><td>Plug in connector</td><td>Cage clamp (Rail mount) type.</td><td>A, B, C*</td></tr><tr><td>Other Field mounted Instrument</td><td>Local JB / Group JB</td><td>Plug in connector</td><td>Cage clamp (Rail mount) type.</td><td>F,G</td></tr><tr><td>RTD</td><td>Temperature transmitter</td><td>Plug in connector</td><td>Screwed, Cage clamp type</td><td>F</td></tr><tr><td>Thermocouple</td><td>Temperature transmitter</td><td>Plug in connector</td><td>Screwed, Cage clamp type</td><td>A, B, C*</td></tr><tr><td>Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/ MCC/SWGR</td><td>Group JB</td><td>Cage clamp (Rail mount) type.</td><td>Cage clamp (Rail mount) type.</td><td>F,G</td></tr></table>					Application		Type Of Termination		Type Of Cable	FROM (A)	TO (B)	END A	END B	Valves/dampers drives (Integral Junction box)	Marshalling / Marshalling – cum Termination Cubicle / local group JB	Plug in connector	Post 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	Local junction box / 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	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/ MCC/SWGR	Group JB	Cage clamp (Rail mount) type.	Cage clamp (Rail mount) type.	F,G
Application		Type Of Termination		Type Of Cable																																																		
FROM (A)	TO (B)	END A	END B																																																			
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Transmitters, Process Actuated switches mounted in LIE/LIR	Integral Junction box of LIE/LIR	Plug in connector	Cage clamp (Rail mount) type.	F,G																																																		
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EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2		SUB-SECTION-IIIC-07 INSTRUMENTATION CABLES	PAGE 7 OF 13																																																	

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC
	Application		Type Of Termination		Type Of Cable
	FROM (A)	TO (B)	END A	END B	
	Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/ Group JB / MCC/SWGR	Marshalling / Marshalling – cum Termination Cubicle	Cage clamp (Rail mount) type.	Cage clamp (Post mounted) type.	F,G
	Marshalling cubicle/ Termination Cabinet	Electronic system cabinet	Cage clamp (Post mounted) type.	Plug-in connector / other system as per Mfr.'s Standard	Internal wiring
	Marshalling/ Termination System Cabinets	UCD mounted equipments	Cage clamp (Post mounted) type.	Plug in connector / Cage clamp type (rail mounted).	F,G (with plug-in connect or at one end)
	DDCMIS/PLC cabinets	PC, Printers etc.	Plug in connector	Plug in connector	Mfr.'s Standard
	Notes				
	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 * For high temperature applications only.				
4 . For connection between field/JB and DDCMIS marshalling cabinet minimum 4 pair instrumentation cable shall be used.					
5 All the spare cores of instrumentation cable have to be terminated in Marshalling cabinets/ DCS panel end.					
6 For Cable type and cable termination scheme for the instruments/ equipment that are connected to Steam Turbine and Generator (STG) control system defined at Part A, sub section IIC, clause no. 2.03.01 (a) (ii) above and hydrogen generation plant auxiliaries system, Contractor's standard and proven practice is also acceptable. However, for termination of instrumentation cable at marshalling cabinets/DCS panel end, cage-clamp termination shall be offered. For power and control cable termination, Contractor's standard and proven practice would be acceptable					
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2		SUB-SECTION-IIIC-07 INSTRUMENTATION CABLES	PAGE 8 OF 13

CLAUSE NO.	TECHNICAL REQUIREMENTS		
6.00.00	TERMINAL BLOCKS		
6.01.00	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 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.		
6.02.00	All the terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, partitions, small partitions, transparent covers, support brackets, distance sleeves, warning label, marking, etc.		
6.03.00	The marking on terminal strips shall correspond to the terminal numbering on wiring diagrams. At least 20% spare unused terminals shall be provided everywhere including local junction boxes, instrument racks/enclosures, termination/marshalling cabinets, etc. All terminal blocks shall be numbered for identification and grouped according to the function. Engraved labels shall be provided on the terminal blocks.		
6.04.00	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.		
6.05.00	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.		
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	All internal wires shall be provided with tag and identification nos. etched on tightly fitted ferules at both ends. All wires directly connected to trip devices shall be distinguished by one additional red colour ferrule.		
7.03.00	All external connection shall be made with one wire per termination point. Wires shall not be tapped or spliced between terminal points.		
7.04.00	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.		
7.05.00	All the special tools as may be required for solder less connections shall be provided by Bidder.		
7.06.00	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.)
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-07 INSTRUMENTATION CABLES
			PAGE 9 OF 13

CLAUSE NO.	TECHNICAL REQUIREMENTS												
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 bottom tier of the tray stack. The distance between instrumentation cables and those of other system shall be as follows: <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. 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	Not in use												
8.05.00	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	No jointing is permissible for Instrumentation cables. For other cables Jointing for more than 250 Meters run of cable shall be permitted.											
	5	Buried cable protection											
		With concrete slabs; Route markers at every 20 Meters along the route & at every bend.											
	6	Road Crossings											
		Cables to pass through buried high density PE pipes encased in PCC. At least 300											
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-07 INSTRUMENTATION CABLES	PAGE 10 OF 13									

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	mm clearance shall be provided between - HT power & LT power cables, - LT power & LT control/instrumentation cables, Spacing between cables of same voltage grade shall be in accordance with the derating criteria adopted for cable sizing. 7 Segregation (physical isolation to prevent fire jumping) - a All cable associated with the unit shall be segregated from cables of other Units. - 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. 8 Cable clamping 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. 9 Optical fiber cables (OFCs) : Outside Building Area - to be laid necessarily inside GI conduit with support from cable tray/Trestle structure Inside Building Area – to be laid on separate cable sub-trays While buried- in separate buried trench approx.1.0 meter depth, to be laid in 2” rodent proof HDPE conduits covered with sand, brick, laid breadth-wise and soil along the pipe line route by contractor; 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; While crossing canals/river- to be laid in rodent proof HDPE conduits within hume pipe. 10 Laying of Network Cable (UTP/STP) : Out side Building Area- to be laid necessarily inside GI conduits with support from cable tray / Trestle structure. Inside Building Area- to be laid necessarily inside GI conduits on separate cable sub-trays. 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 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.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-07 INSTRUMENTATION CABLES	PAGE 11 OF 13

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
9.04.00	The Bidder shall be responsible for proper grounding of all equipment under this 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.			
9.05.00	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	FIELD MOUNTED LOCAL JUNCTION BOXES (i) No. of ways 12/24/36/48/64/72/96/128 with 20% spares terminals. (ii) Material and Thickness 4mm thick Fiberglass Reinforced Polyester (FRP). (iii) Type Screwed at all four corners for door. Door gasket shall be of synthetic rubber. (iv) Mounting clamps and accessories Suitable for mounting on walls, columns, structures etc. The brackets, bolts, nuts, screws, glands required for erection shall be of SS, included in Bidders scope of supply. (v) Type of terminal blocks Rail mounted cage-clamp type suitable for conductor size upto 2.5 mm ² . A M6 earthing stud shall be provided. (vi) Protection Class IP: 55 minimum for indoor & IP-65 minimum for outdoor applications. (vii) Grounding To be provided. (viii) Color RAL 7035			
11.00.00	CONDUITS			
11.01.00	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 galvanized steel with , water leak, fire and rust proof protected <i>for the areas of Mills,Drum, Main Steam, RH steam Air Heaters and Furnace, BFPDT's</i> . <i>And for remaining applications, water leak, fire and rust proof flexible GI conduits shall be provided.</i> The temperature rating of flexible conduit shall be suitable for actual application.			
11.02.00	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.			
11.03.00	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			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-07 INSTRUMENTATION CABLES	PAGE 12 OF 13

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
11.04.00 11.05.00 12.00.00 12.01.00 12.02.00	with NEC requirements for the area classification. 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. Conduits shall be securely fastened to all boxes and cabinets. CABLE SUB-TRAY & SUPPORT 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 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). 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.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)	TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-07 INSTRUMENTATION CABLES	PAGE 13 OF 13



**C&I SPECIFICATION FOR
HYDROGEN GENERATION PLANT**

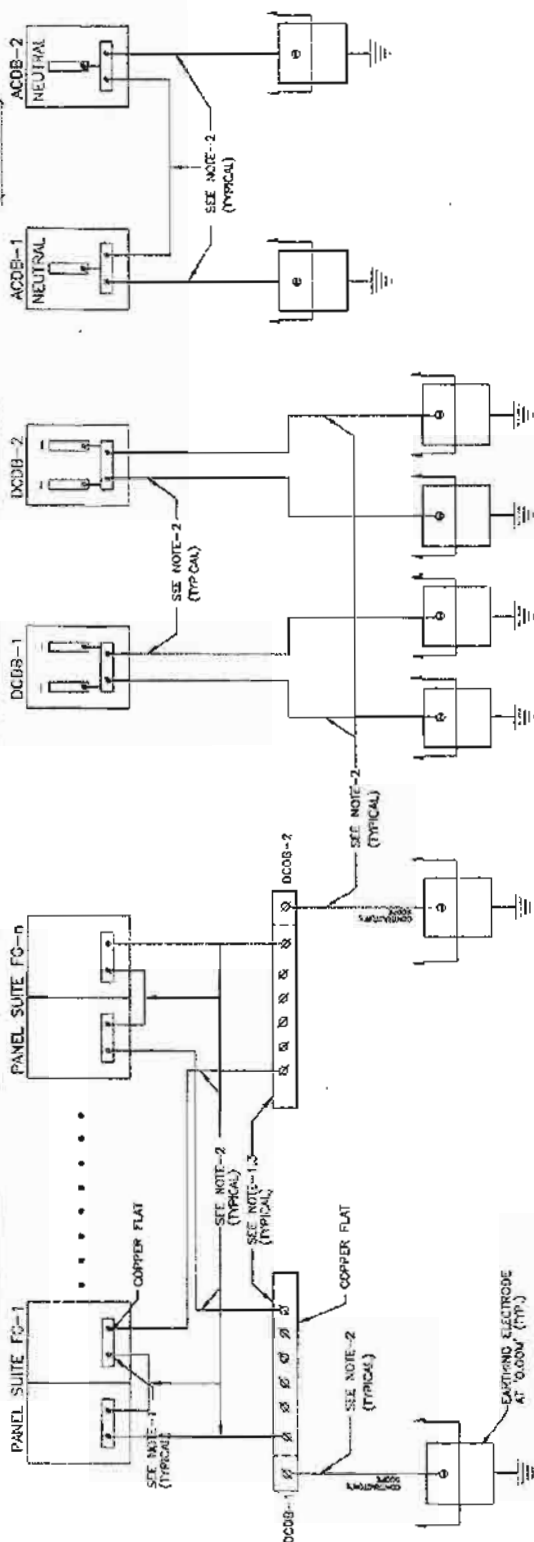
SECTION: C
SUB SECTION: C&I

INSTRUMENT INSTALLATION DRAWING

SYSTEM/SHIELD GROUNDING (TYPICAL)

POWER GROUNDING (TYPICAL)

ACDB GROUNDING (TYPICAL)



NOTES:-

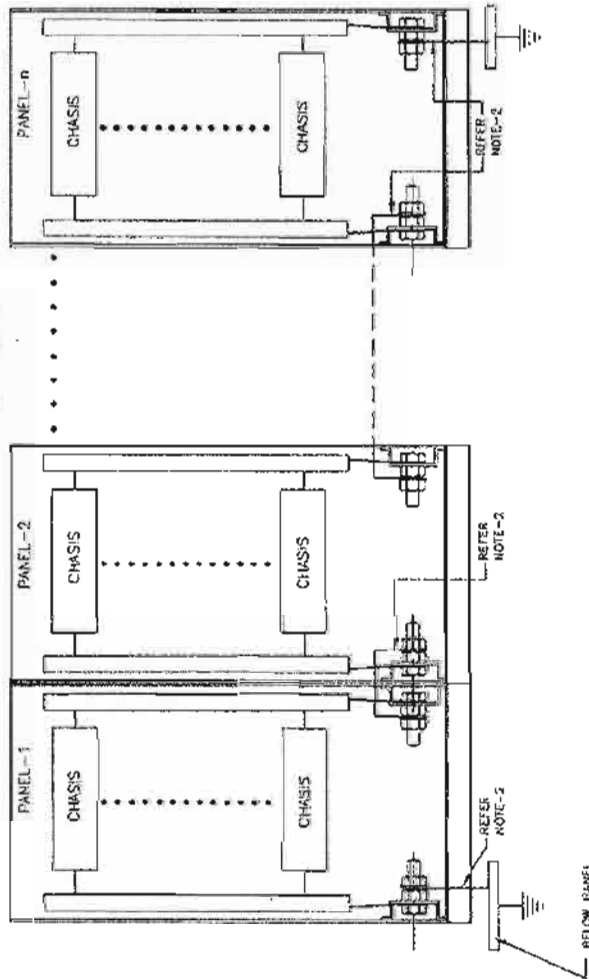
1. SUPPLY, ERECTION, TERMINATION OF CABLES, FLATS ETC. REQUIRED FOR PROPER GROUNDING OF CONTRACTOR'S CONTROL SYSTEM, SYSTEM CABINETS, POWER SUPPLY CABINETS ETC. ARE IN THE SCOPE OF CONTRACTOR.
2. CABLE IN CONTRACTOR'S SCOPE.
3. TO BE LOCATED IN DCDB.
4. EXACT LOCATION, ARRANGEMENTS OF FLATS ETC. SHALL BE AS FINALISED WITH CONTRACTOR.
5. DURING DETAILED ENGINEERING.
6. CABINET BODY, CABINET BOTTOM PLATE, CABINET DOORS ARE TO BE CONNECTED TO PANEL EARTH FLAT COPPER CABLE BY CONTRACTOR.

FOR TENDER PURPOSE ONLY

NTPC LIMITED (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION		TYPICAL THERMAL POWER PROJECT	
PROJECT		TITLE	
GROUNDING SCHEME FOR CABINETS / PANELS / POWER SUPPLY		INSTRUMENTATION CABLING DIAGRAM	
REV. NO.	REV. NO.	SCALE	DRG. NO.
A	A	A3	0000-999-POI-A-019A
DESCRIPTION		SI-1 OF 2	
DESIGNER		CHECKED BY	
DATE		DATE	
31-08-12		31-08-12	

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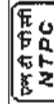
GROUNDING FOR EACH ROW OF PANELS (TYPICAL)



NOTES:-

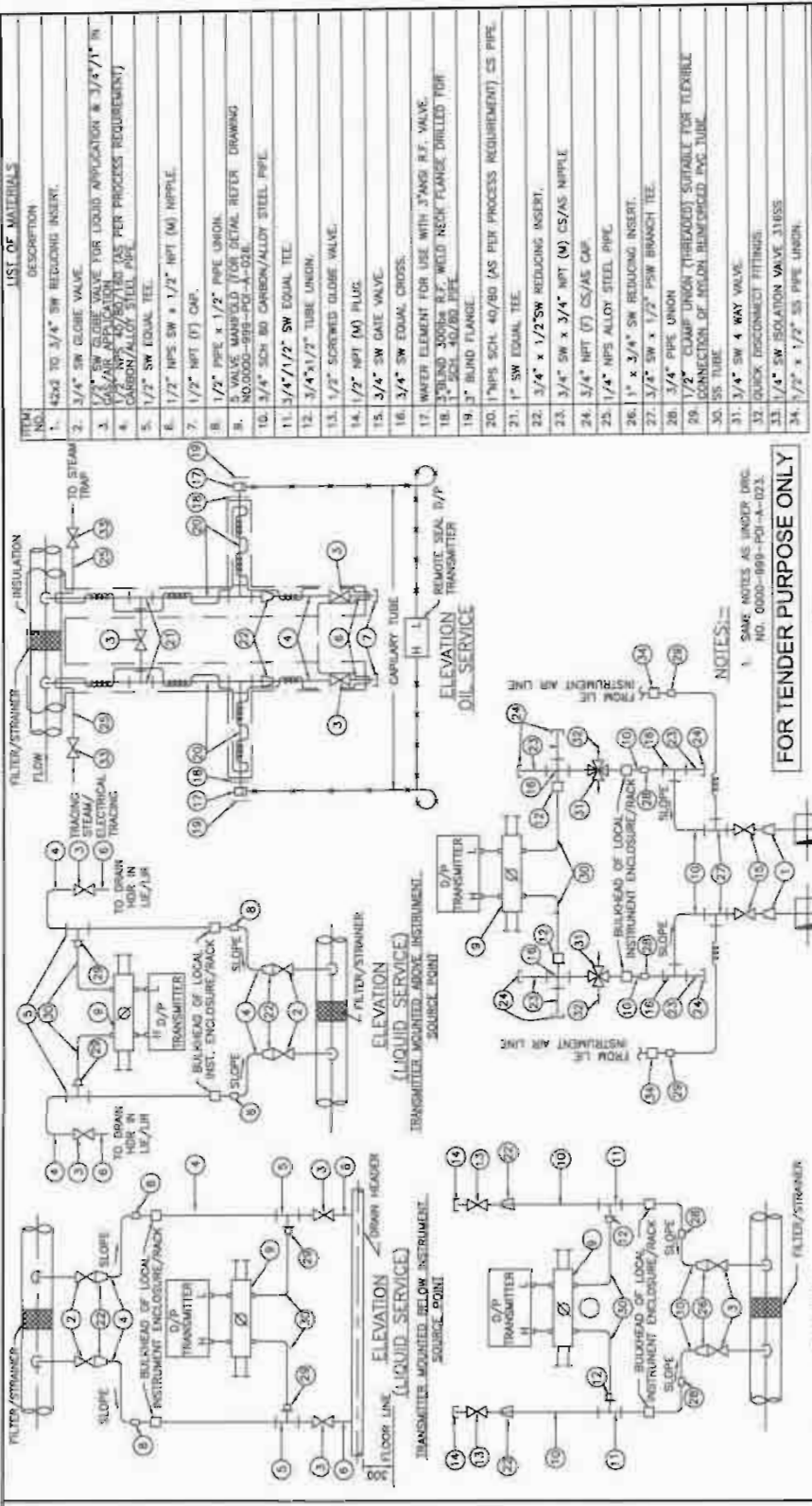
1. SUPPLY, ERECTION, TERMINATION OF CABLES, FLATS ETC. REQUIRED FOR PROPER GROUNDING OF CONTRACTOR'S CONTROL SYSTEM, SYSTEM CABINETS, POWER SUPPLY CABINETS ETC. ARE IN THE SCOPE OF CONTRACTOR.
2. CABLE IN CONTRACTOR'S SCOPE.
3. TO BE LOCATED IN DCDB.
4. EXACT LOCATION, ARRANGEMENTS OF FLATS ETC. SHALL BE AS FINALISED WITH CONTRACTOR DURING DETAILED ENGINEERING.
5. CABINET BODY, CABINET BOTTOM PLATE, CABINET DOORS ARE TO BE CONNECTED TO PANEL EARTH FLAT COPPER CABLE BY CONTRACTOR.

FOR TENDER PURPOSE ONLY



NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT										TYPICAL THERMAL POWER PROJECT									
TITLE										INSTRUMENTATION CABLING DIAGRAM GROUNDING SCHEME FOR CABINETS / PANELS / POWER SUPPLY									
REV. NO.	A	FIRST ISSUE	DRAWING DESIGN CRD.	M	E	C	CAI	ARCH.	APPR	DATE	21.08.12	SCALE	A3	N.T.S.	DEC. NO.	0000-999-POI-A-019A	REV. NO.	A	SHEET NO. 2
DESCRIPTION		CLEARED BY																	
SCALE		A3		N.T.S.		DEC. NO.		0000-999-POI-A-019A		REV. NO.									
SIZE		A3		N.T.S.		SCALE		0000-999-POI-A-019A		REV. NO.									
REV. NO.		A		A		A		A		A									



LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	42x2 TO 3/4" SW REDUCING INSERT.
2.	3/4" SW GLOBE VALVE.
3.	1/2" SW GLOBE VALVE FOR LIQUID APPLICATION & 3/4" x 1/2" IN GAS/AIR APPLICATION.
4.	1/2" NPS 40/80 TEE (AS PER PROCESS REQUIREMENT)
5.	1/2" SW EQUAL TEE.
6.	1/2" NPS SW x 1/2" NPT (M) NIPPLE.
7.	1/2" NPT (F) CAP.
8.	1/2" PIPE x 1/2" PIPE UNION.
9.	3 VALVE MANIFOLD FOR RETAIL RETER DRAWING NO.0000-999-POI-A-028.
10.	3/4" SCH 80 CARBON/ALLOY STEEL PIPE.
11.	3/4" x 1/2" SW EQUAL TEE.
12.	3/4" x 1/2" TUBE UNION.
13.	1/2" SCREWED GLOBE VALVE.
14.	1/2" NPT (M) PLUS.
15.	3/4" SW GATE VALVE.
16.	3/4" SW EQUAL CROSS.
17.	WATER ELEMENT FOR USE WITH 3" ANSI R.F. VALVE.
18.	3" BLIND 300RA R.F. WELD NECK FLANGE DRILLED FOR 1" SCH 40/80 TEE.
19.	3" BLIND FLANGE.
20.	1" NPS SCH. 40/80 (AS PER PROCESS REQUIREMENT) CS PIPE.
21.	1" SW EQUAL TEE.
22.	3/4" x 1/2" SW REDUCING INSERT.
23.	3/4" SW x 3/4" NPT (M) CS/AS NIPPLE.
24.	3/4" NPT (F) CS/AS CAP.
25.	1/4" NPS ALLOY STEEL PIPE.
26.	1" x 3/4" SW REDUCING INSERT.
27.	3/2" SW x 1/2" PSW BRANCH TEE.
28.	3/4" PIPE UNION.
29.	1/2" CLAMP UNION (THREADED) SUITABLE FOR TYPICAL CONNECTION OF RETON REINFORCED PVC TUBE.
30.	SS TUBE.
31.	3/4" SW 4 WAY VALVE.
32.	QUICK DISCONNECT FITTING.
33.	1/4" SW ISOLATION VALVE 316SS
34.	1/2" x 1/2" SS PIPE UNION.

FOR TENDER PURPOSE ONLY

NOTES:
1. SAME NOTES AS UNDER Dwg. NO. 0000-999-POI-A-028.

NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INSTRUMENT INSTALLATION DIAGRAM
DIFF. PRESS. MEASUREMENT (LIQUID, OIL, AIR/GAS SERVICE)

REV. NO.	REV. NO.	DATE	DATE	APPROVED	APPROVED	SCALE	SCALE	DIRG. NO.	DIRG. NO.
A	1	21/08/12	21/08/12			A3	A3	0000-999-POI-A-030	0000-999-POI-A-030

DESCRIPTION

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LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	3/4" 1/2" NPS SCH 40/160/180/191 (AS PER PROCESS REQUIREMENT) CARBON /ALLOY STEEL PIPE.
2.	3/4" 5W GLOBE VALVE.
3.	3/4" 5W UNION.
4.	3/4" NPT GLOBE VALVE.
5.	3/4" NPT (M) CAP.
6.	3/4" NPT (F) UNION CONNECTION.
7.	1" 5W EQUAL UNION.
8.	1" x 1/2" 5W REDUCING INSERT.
9.	1" 5W EQUAL TEE.
10.	1/2" 5W GLOBE VALVE.
11.	1/2" NPS 5W 1/2" NPT(M) CS/AS NIPPLE.
12.	1/2" NPT (F) CAP.
13.	3/4" x 1/2" NPS SCH 40/160 CS/AS PIPE.
14.	1/2" NPS SCH 40/160 CS/AS NIPPLE.
15.	1" 5W GLOBE VALVE.

NOTES:-

1. FOR LEVEL GAUGE 3/4" AND FOR LEVEL SWITCH 1" PROCESS CONNECTION SHALL BE PROVIDED.

2. NOTES UNDER Dwg. NO. 0000-999-POI-A-023 (WHICHEVER ARE RELEVANT).

LOCAL LEVEL INDICATION USING GAUGE GLASS

LOCAL LEVEL INDICATION USING MULTIPLE GAUGES

FLOAT OR DISPLACER OPERATED EXTERNAL CAGE TYPE LEVEL SWITCH INSTALLATION

FLOAT OR DISPLACER OPERATED EXTERNAL CAGE TYPE LEVEL SWITCH INSTALLATION

FOR TENDER PURPOSE ONLY

NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

TYPICAL THERMAL POWER PROJECT

INSTRUMENT INSTALLATION DIAGRAM
(LEVEL GAUGE & SWITCHES)

PROJECT

TITLE

SIZE A3 **SCALE** N.T.S. **REV. NO.** A

0000-999-POI-A-031

DESCRIPTION

APPRO. DATE 21.08.12

DESIGN CHD. Y.G. **APPD. DATE** 21.08.12

CHECKED BY Y.G. **APPRO. DATE** 21.08.12

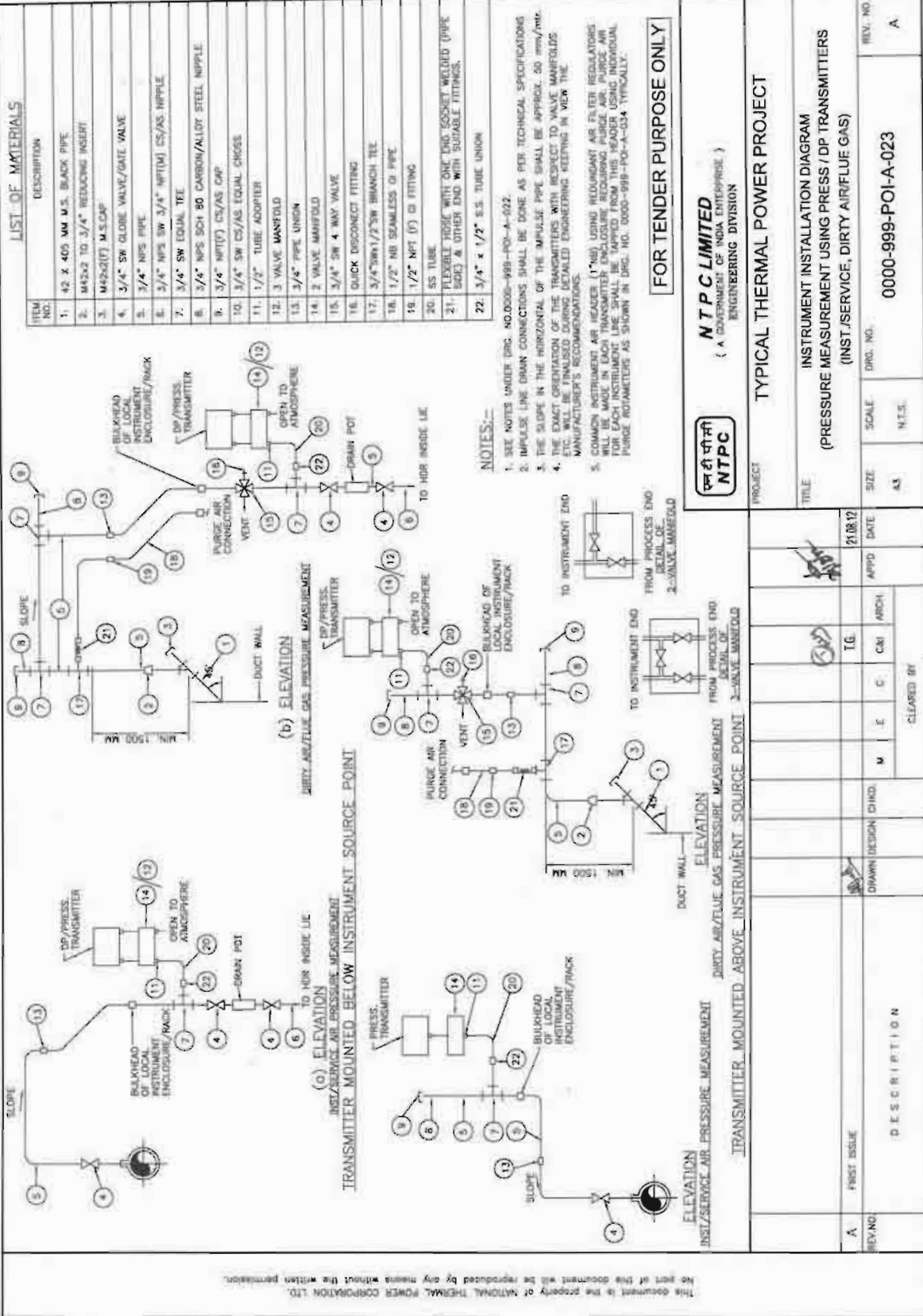
REV. NO. A

DESCRIPTION

APPRO. DATE 21.08.12

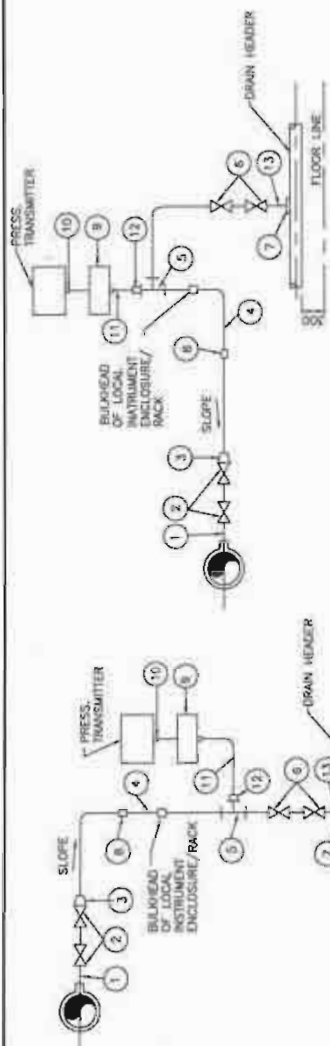
DESIGN CHD. Y.G. **APPD. DATE** 21.08.12

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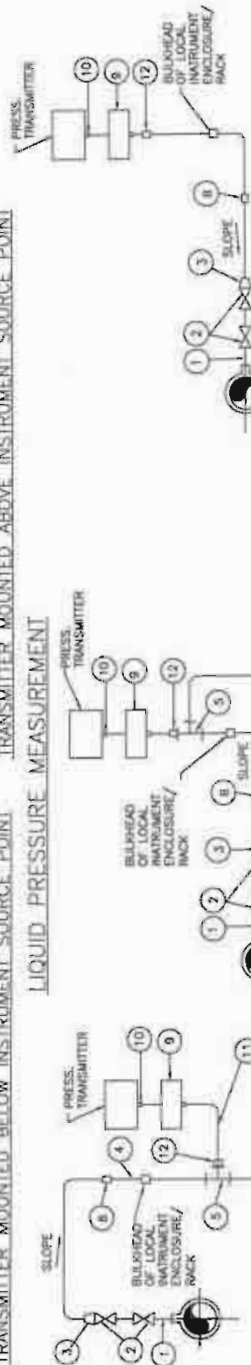


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ITEM NO.	DESCRIPTION
1.	1/2" 3/16" NPS SCH. 80/160 705/981 SUPPLY OF MATERIAL, SAME AS THAT OF MAIN PIPE.
2.	3/4" 1" SW GLOBE VALVE
3.	3/4" 1" TO 1/2" REDUCING INSERT
4.	1/2" NPS PIPE
5.	1/2" SW EQUAL TEE
6.	1/2" SW GLOBE VALVE
7.	1/2" NPS SCH. 80/160 SW 1/2" CS/AS COUPLER
8.	1/2" PIPE UNION
9.	2 1/2" VALVE HANDLED (FOR DETAIL SEE DRAWING 80-0055-102-FEB-4-52)
10.	SUITABLE ADAPTER
11.	SS TUBE
12.	1/2" PIPE X 1/2" TUBE UNION
13.	1/2" NPS SCH. 80/160 SW 1/2" NPT(M) CS/AS NIPPLE



101. _____ ELEVATION _____
 TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT
 TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT
 ELEVATION _____ 11.

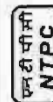


ELEVATION
VACUUM PRESSURE MEASUREMENT

NOTES:-

1. SAME NOTES UNDER ORG. NO. 0000-999-FCI-A-023.
2. FOR VACUUM APPLICATION OTHER PORT OF TRANSMITTER SHALL BE KEPT OPEN TO ATMOSPHERE.

FOR TENDER PURPOSE ONLY



NTPCLIMITED

NIPCO LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE.)
ENGINEERING DIVISION

TYPICAL THERMAL POWER PROJECT

INSTRUMENT INSTALLATION DIAGRAM
(PRESSURE MEASUREMENT USING PRESS /DP
TRANSMITTERS STEAM/LIQUID VACUUM)

TRANSMITTERS STEAM/LIQUID VACUUM)										REV. NO.
										A
										0000-999-POI-A-025
										SCALE
										SIZE
										DATE
										APPRO
										ARCH
										M
										E
										C
										DI
										CHD
										DESIGN
										DRAWN
										DESCRIPTION
										REV. NO.
										A

CLAUSE NO.	TECHNICAL REQUIREMENTS											
	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 on as required basis for the connection of all instruments and control equipments of entire plant.											
1.01.01	IMPULSE PIPING, TUBING, FITTINGS, VALVES AND VALVE MANIFOLDS											
1.01.02	All impulse pipes shall be of seamless type conforming to ANSI B36.10 for schedule numbers. The size of impulse pipe shall be ½" for Steam & Water Application and ¾" for Air & Flue Gas applications. The rating of material of impulse pipes, tubes, fittings, valves and their installation thereof shall conform to the latest edition of standards as per following table: <table><tr><td>Impulse Pipes, Tubes (Material, Rating)</td><td>ANSI B31.1, ANSI B31.1a, ANSI/ISA 77.70</td></tr><tr><td>Valves (Material, Pr. Class, Size)</td><td>ASTM A182/ASTM A105 as per ASME 16.34</td></tr><tr><td>Fittings (Size, Rating, Material)</td><td>ANSI B31.1, ANSI B31.1a, ASME B16.11-2009</td></tr><tr><td>Installation Schemes</td><td>BS 6739-2009, ANSI/ISA 77.70</td></tr></table> Stainless steel tube shall be provided inside enclosures & racks from tee connection to valve manifold and then to instrument. 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. Two root valves are to be used wherever pressure is more than 40 Kg/cm² or Temp>280 °C. The end connections of valves shall be of socket welded type. Typical installation scheme of DP Transmitter (inside LIE/LIR) mounted below instrument source point is indicated in Drg. No. 0000-999-POI-A-036. Same scheme with necessary changes shall be applied for other instruments.				Impulse Pipes, Tubes (Material, Rating)	ANSI B31.1, ANSI B31.1a, ANSI/ISA 77.70	Valves (Material, Pr. Class, Size)	ASTM A182/ASTM A105 as per ASME 16.34	Fittings (Size, Rating, Material)	ANSI B31.1, ANSI B31.1a, ASME B16.11-2009	Installation Schemes	BS 6739-2009, ANSI/ISA 77.70
Impulse Pipes, Tubes (Material, Rating)	ANSI B31.1, ANSI B31.1a, ANSI/ISA 77.70											
Valves (Material, Pr. Class, Size)	ASTM A182/ASTM A105 as per ASME 16.34											
Fittings (Size, Rating, Material)	ANSI B31.1, ANSI B31.1a, ASME B16.11-2009											
Installation Schemes	BS 6739-2009, ANSI/ISA 77.70											
1.01.03	The valve manifolds of 316 SS with pressure rating suitable for intended application shall be provided as given below: <table><tr><th>Manifold</th><th>Application/M Measurement</th></tr><tr><td>2 Valve</td><td>Pressure measurements using pressure transmitters/pressure switches</td></tr><tr><td>3 Valve</td><td>Pressure measurements using differential pressure transmitter/ switches</td></tr><tr><td>5 Valve</td><td>Differential Pressure, Flow and Level Measurements</td></tr></table> For Pr./D.P gauges, two-way globe/gate valve shall be provided on each impulse line to the instrument in Fluid/Air & Flue Gas applications respectively .				Manifold	Application/M Measurement	2 Valve	Pressure measurements using pressure transmitters/pressure switches	3 Valve	Pressure measurements using differential pressure transmitter/ switches	5 Valve	Differential Pressure, Flow and Level Measurements
Manifold	Application/M Measurement											
2 Valve	Pressure measurements using pressure transmitters/pressure switches											
3 Valve	Pressure measurements using differential pressure transmitter/ switches											
5 Valve	Differential Pressure, Flow and Level Measurements											
2.00.00	AIR SUPPLY PIPING											
2.01.01	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 and Service air supply shall be provided for continuous and intermittent purging respectively for all transmitters of mill, dirty air and flue gas applications. Purging Scheme shall be as per Drg. No. 0000-999-POI-A-036.											
2.03.00	The Contractor shall also provide SS Tubing and associated fittings (screwed type) of suitable sizes for all pneumatic equipments/actuators (including supply air, signal air and output to actuators) conforming to ANSI 31.1 and 31.3 standard. All other air supply lines shall be of mild steel hot dipped galvanized inside and outside as per IS-1239, heavy duty											
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-06 PROCESS CONNECTION AND PIPING	PAGE 1 OF 3								

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	with threaded ends. Fittings for air supply line 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. Air supply piping shall be adequately sloped to prevent accumulation of condensed water within the pipe. The air supply headers, sub-headers and branch pipes shall be supported properly by clamps or supports.		
2.04.00	The instrument/service air supply to each equipment/devices requiring air supply shall be provided by a well designed air distribution scheme comprising of 2" GI Pipe Header feeding 1" GI Pipe sub-header feeding ½" pipe at each equipment/device. Instrument air filters cum regulator set with mounting accessories shall be provided for each pneumatic device requiring air supply except for Ash Handling System wherein it shall be provided on instrument air header at each location.		
2.05.00	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 be union type & trim material shall be stainless steel, body rating 150 pounds ASA. The valve sizes shall be ½ inch to 2 inch.		
2.06.00	Instrument air filters cum regulator set with mounting accessories shall be provided for 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 blowdown valve. The end connection shall be as per the requirement to be finalized during detailed engineering.		
3.00.00	INSTALLATION AND ROUTING		
3.01.01	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. Impulse piping shall be supported at an interval not exceeding 1.5 meters. The slope of the impulse pipe from the process connection to the instrument shall be as per ANSI/ISA 77.70 latest edition and BS 6739-2009. All impulse piping shall be installed to permit free movement due to thermal expansion. Wherever required expansion loops shall be provided. Condensate pots shall be provided for all level measurements in steam and water services, all flow measurement in steam services and for flow measurements in water services above 120 Deg. C. Colour coding of all impulse pipes shall be done by the Contractor in line with the colour coding being followed for the parent pipes.		
4.00.00	SHOP AND SITE TESTS		
4.01.01	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.		
4.01.02	Hydrostatic and Pneumatic leakage tests shall be performed on all pipes, tubing and systems and shall conform to ANSI B31.1.		
5.00.00	LOCAL INSTRUMENT ENCLOSURE AND RACKS All transmitters, switches etc. in Boiler Turbine Generator measurements (except for all fuel oil applications) shall be suitably grouped together and mounted inside (i) local instruments enclosures in case of open areas of the plant like boiler area, etc. and (ii) In local instrument racks in case of covered areas like Turbine/Generator area. The GA of LIE with purging indicated in the Drg. No. 0000-999-POI-A-036 is to be followed by contractor. The GA of LIR shall be similar to LIE except for front/rear doors and side panels.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-06 PROCESS CONNECTION AND PIPING
			PAGE 2 OF 3

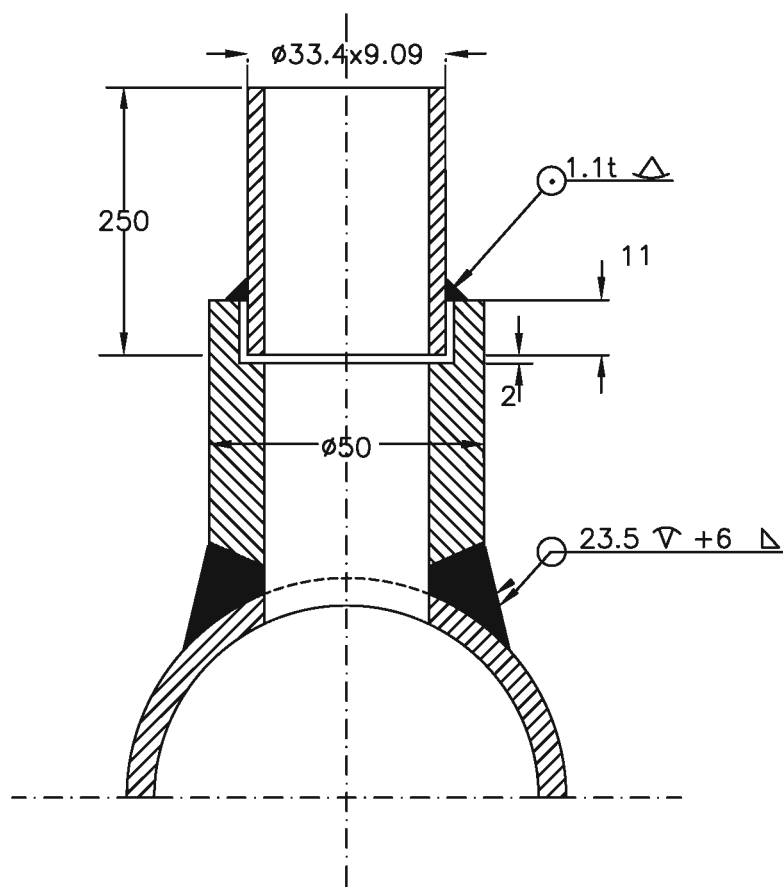
CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
5.01.00	The internal layout shall be such that the impulse piping/ blow down lines are accessible from back side of the enclosure / rack and the transmitters etc. are accessible from front side for easy maintenance. Bulkheads, especially designed to provide isolation from process line vibration shall be installed on instrument enclosures/racks to meet the process sensing line connection requirement. Vibration dampeners shall be installed for each enclosure / rack. The Degree of Protection of LIE and JB of LIE/LIR shall be IP-55. 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. 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. Contractor shall provide not more than three variants for LIE/LIR with respect to max. no. transmitters mounted in each LIE/LIR. ENCLOSURE / RACKS FOR DUAL I/P TEMPERATURE TRANSMITTERS All Dual Input temperature transmitters in Boiler Turbine Generator measurements shall be suitably grouped together and mounted inside (i) Enclosures in case of open areas of the plant like boiler area, etc. and (ii) Racks in case of covered areas like Turbine/Generator area. Integral JB shall be provided with each Enclosure and Rack. The internal layout shall be such that the transmitters are accessible from both front and back side of the enclosure / rack for easy maintenance. Enclosure/ Racks shall be of robust and rugged design. Vibration dampeners shall be installed for each enclosure / rack. The Degree of Protection of Enclosure and JB shall be IP-55. Enclosure and Racks shall be free standing type. Enclosures/Racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein. Contractor shall provide not more than five variants for Enclosure/ Rack with respect to max. no. transmitters mounted in each Enclosure/ Rack. However, the maximum number of Transmitters that can be grouped in one Enclosure/ Rack shall be decided during detail Engineering.			
	6.00.00	INSTALLATION OF OTHER INSTRUMENTS: For installation and routing of other field mounted instruments which are not covered in Cl. No. 5.00.00, please refer Cl. No 52.04.00(f) of Section-VI, Part-D, Erection Conditions of Contract (ECC) of Technical Specifications.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-06 PROCESS CONNECTION AND PIPING	PAGE 3 OF 3



**C&I SPECIFICATION FOR
HYDROGEN GENERATION PLANT**

SECTION: C
SUB SECTION: C&I

INSTRUMENT STUB DETAILS



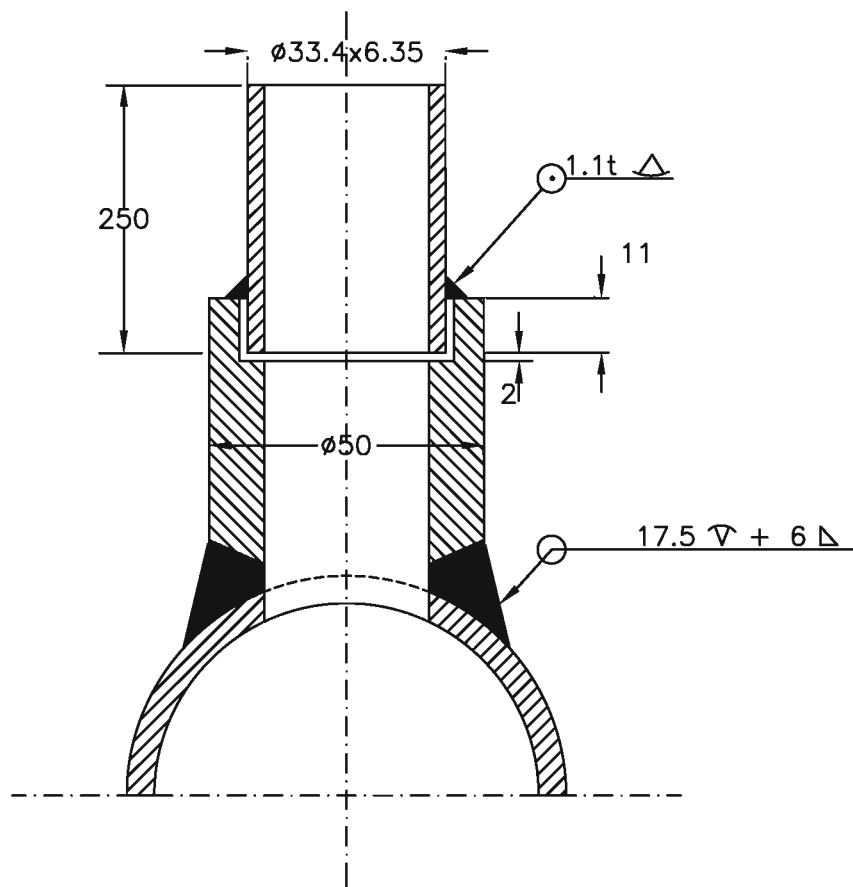
NOTE :

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHOULD BE 250 MM.
3. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
4. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES
5. STUB LENGTH SHALL BE 64mm UPTO 250Nb PIPE, 45mm ABOVE 200Nb PIPE SIZE.



TITLE :
**INSTRUMENT STUB DETAILS
 FOR PRESSURE MEASUREMENT**
 (TEMP > 500 DegC AND CLASS 9000 #)

DRG. NO.
PE-DG-434-145-I101
 REV. 00
 SH. 02 OF 08 SHS.



NOTE :

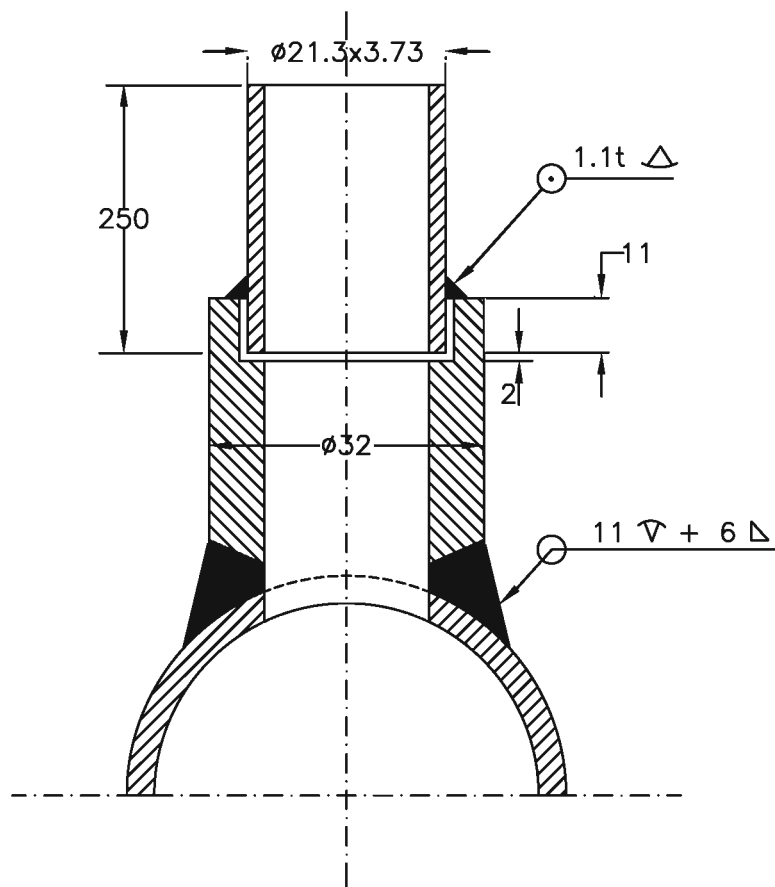
1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
4. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY ($1/64''$ RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES
5. STUB LENGTH SHALL BE 64mm UPTO 250Nb PIPE, 45mm ABOVE 200Nb PIPE SIZE.



TITLE : INSTRUMENT STUB DETAILS FOR PRESSURE MEASUREMENT

(APPLICABLE FOR TEMP< 500 DegC, CLASS 6000#)

DRG. NO.
PE-DG-434-145-I101
REV. 00
SH. 03 OF 08 SHS.



NOTE :

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
4. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY ($1/64''$ RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES
5. STUB LENGTH SHALL BE 64mm UPTO 250Nb PIPE, 45mm ABOVE 200Nb PIPE SIZE.

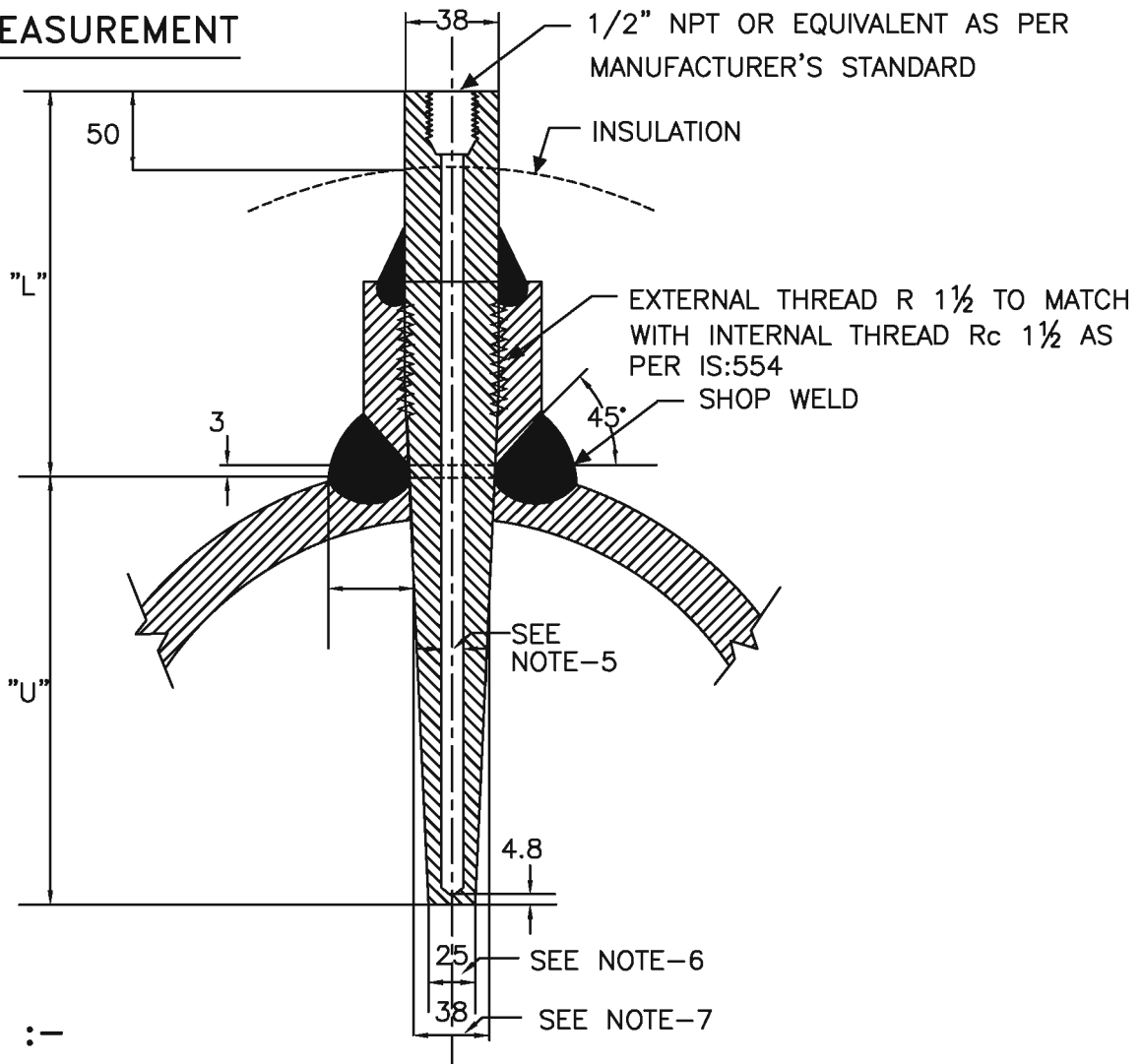


TITLE : INSTRUMENT STUB DETAILS FOR PRESSURE MEASUREMENT

DRG. NO.
PE-DG-434-145-I101
REV. 00
SH. 04 OF 08 SHS.

(SYSTEM PRESS UPTO 40Kg/Cm², TEMP< 400 Deg C)

TEMP. MEASUREMENT



NOTES :-

1. THIS TYPE OF TEMPERATURE BOSS SHALL BE USED FOR THE PROCESS PRESS EQUAL/ ABOVE 40 KG/CM2(g) AND FOR PROCESS TEMP.>400 DEG C EVEN IF THE PROCESS PRESSURE IS LESS THAN 40 KG/CM2(g).
2. THE MATERIAL OF THE BOSS SHALL BE SIMILAR TO PIPING MATERIAL.
3. MATERIAL OF THE THERMOWELL SHALL BE OF 316SS.
4. THERMOWELL SHALL BE DRILLED BAR STOCK TYPE.
5. INTERNAL BORE OF THE THERMOWELL SHOULD BE SELECTED BASED ON THE NORMAL SIZE OF THE SENSING ELEMENT AS PER ASME PTC-19.3.
6. THE BOTTOM DIAMETER OF THE THERMOWELL TYPICALLY SHOWN HERE SHALL BE SUBJECT TO VARIATION BASED ON THE INTERNAL BORE OF THERMOWELL AND THICKNESS OF THERMOWELL MATERIAL TO WITHSTAND THE PROCESS PRESS AND TEMP AS PER ASME PTC-19.3.
7. THERMOWELL SHALL BE SUITABLE TO MATCH THE STUB DIMENSIONS AS PER Rc 1½.
8. THE 'U' & 'L' DIMENSIONS SHALL BE SELECTED BASED ON PARTICULAR APPLICATION.
9. ORIENTATION OF STUB ON VERTICAL/ HORIZONTAL PIPES SHALL BE 90° TO THE CENTRE LINE OF THE PIPES, FOR PIPE SIZE LARGER THAN 4". HEIGHT OF STUB SHALL BE 64mm FOR PIPE OD < 200Nb AND 45mm FOR PIPE OD ≤ 200Nb.
10. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED.

TITLE :

DRG. NO.



INSTRUMENT STUB DETAILS (TEMP)
(APPLICABLE FOR PIPE SIZE ABOVE 4")

PE-DG-434-145-1101

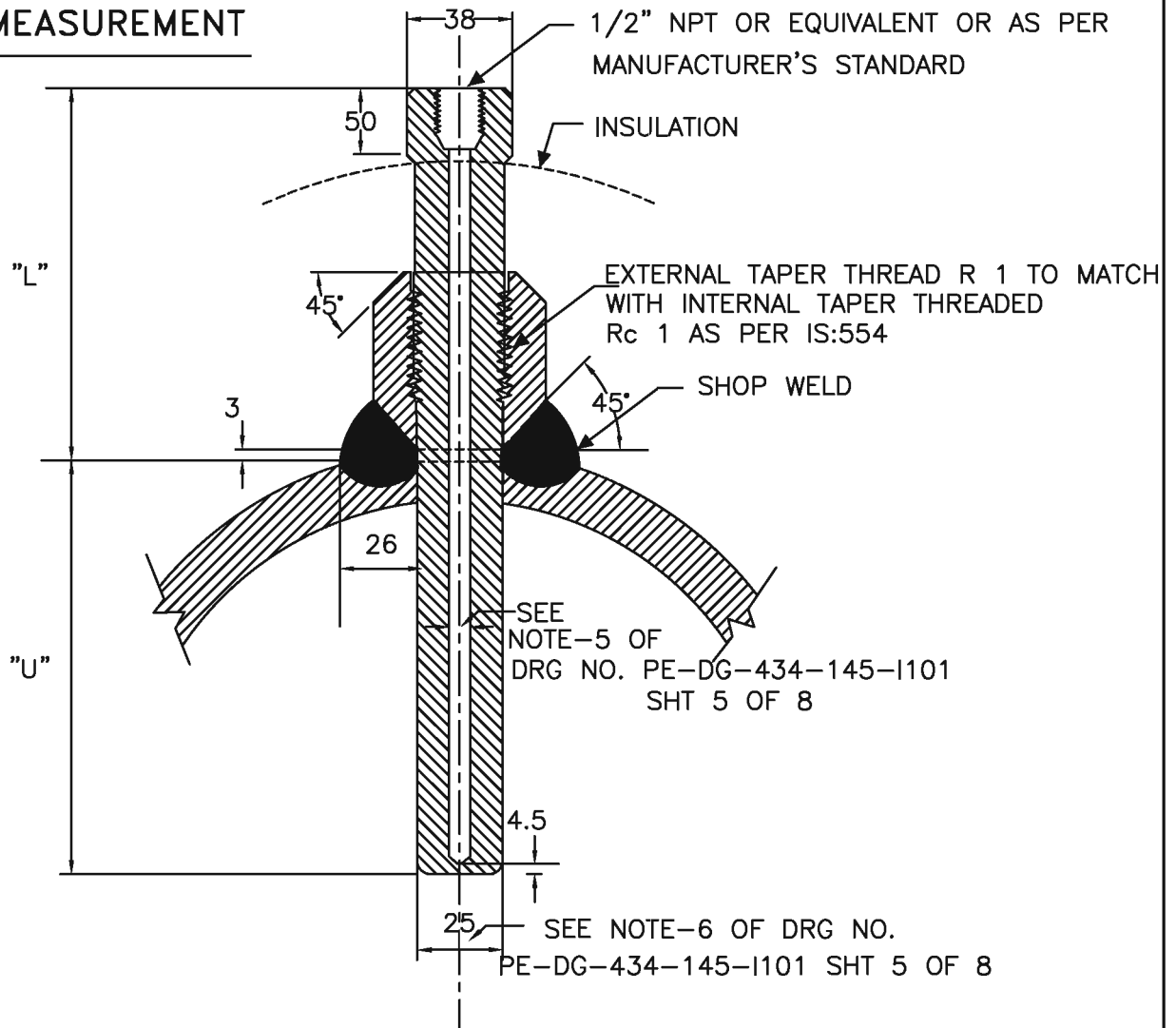
REV. 00

[PROCESS PRESS EQUAL/> 40 Kg/Cm2 (g)

SH. 05 OF 08 SHS.

PROCESS PRESS < 40 Kg/Cm2 (g), TEMP.EQUAL/>400 DEG C]

TEMP. MEASUREMENT



NOTES :-

1. THIS TYPE OF TEMPERATURE BOSS IS APPLICABLE FOR THE PROCESS PRESS/ TEMP. BELOW 40 KG/CM²(g)/400°C.
2. SEE NOTES-2 TO 9 IN SHT. 5 OF 8 OF THIS DRG.
3. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED.



TITLE :

INST. STUB DETAILS (TEMP)

(APPLICABLE FOR PIPE SIZE ABOVE 4")

[PROCESS PRESS < 40 Kg/Cm² (g), TEMP < 400 °C]

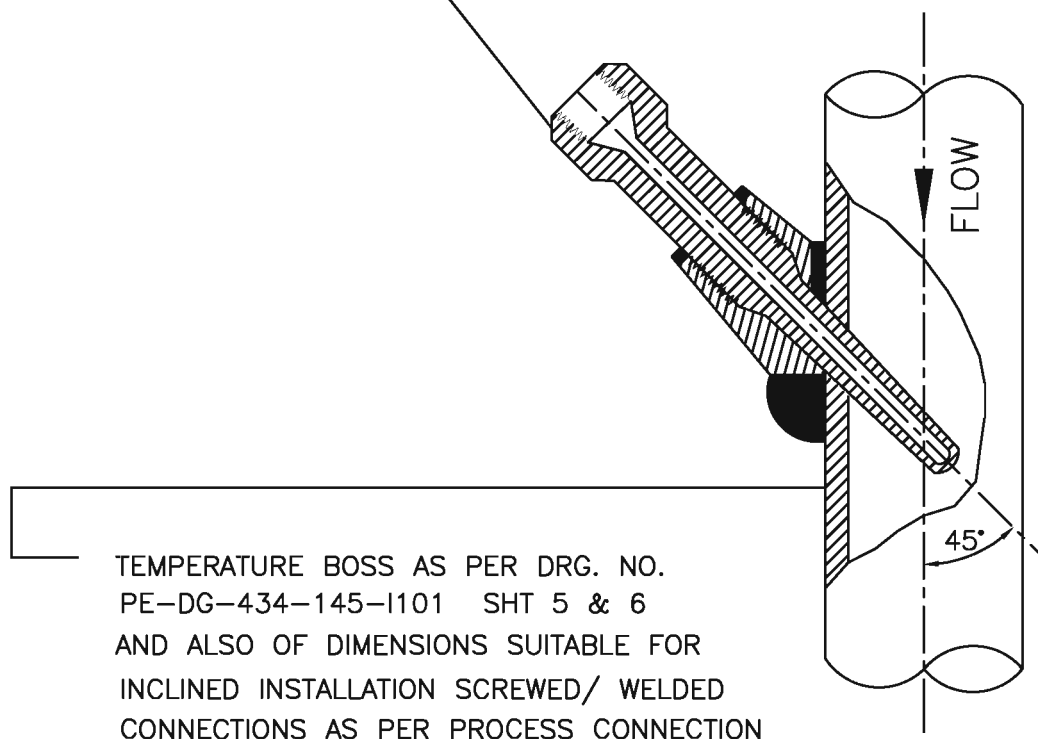
DRG. NO.

PE-DG-434-145-I101

REV. 00

SH. 06 OF 08 SHS.

THERMOWELL SUITABLE FOR THE BOSS
AS PER DRG. NO.
PE-DG-434-145-I101 SHT 5 & 6



NOTES :-

1. INCLINED INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MIN. 3" LINE SIZE.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF 3" SIZE OF MAIN PIPING SPECIFICATION SHALL BE USED.
3. THIS TYPE OF INSTALLATION IS APPLICABLE FOR HORIZONTAL AND VERTICAL PIPE SECTION.
4. FOR STEAM SERVICES EXPANDER SECTION MAY BE USED ONLY IN VERTICAL RUN.
5. THE EXPANDER SECTION SHALL BE OF ADEQUATE LENGTH (ATLEAST 3-4 TIMES DIA OF THE MAIN PROCESS PIPE AT BOTH SIDE OF INSTALLED THERMOWELL).



TITLE :

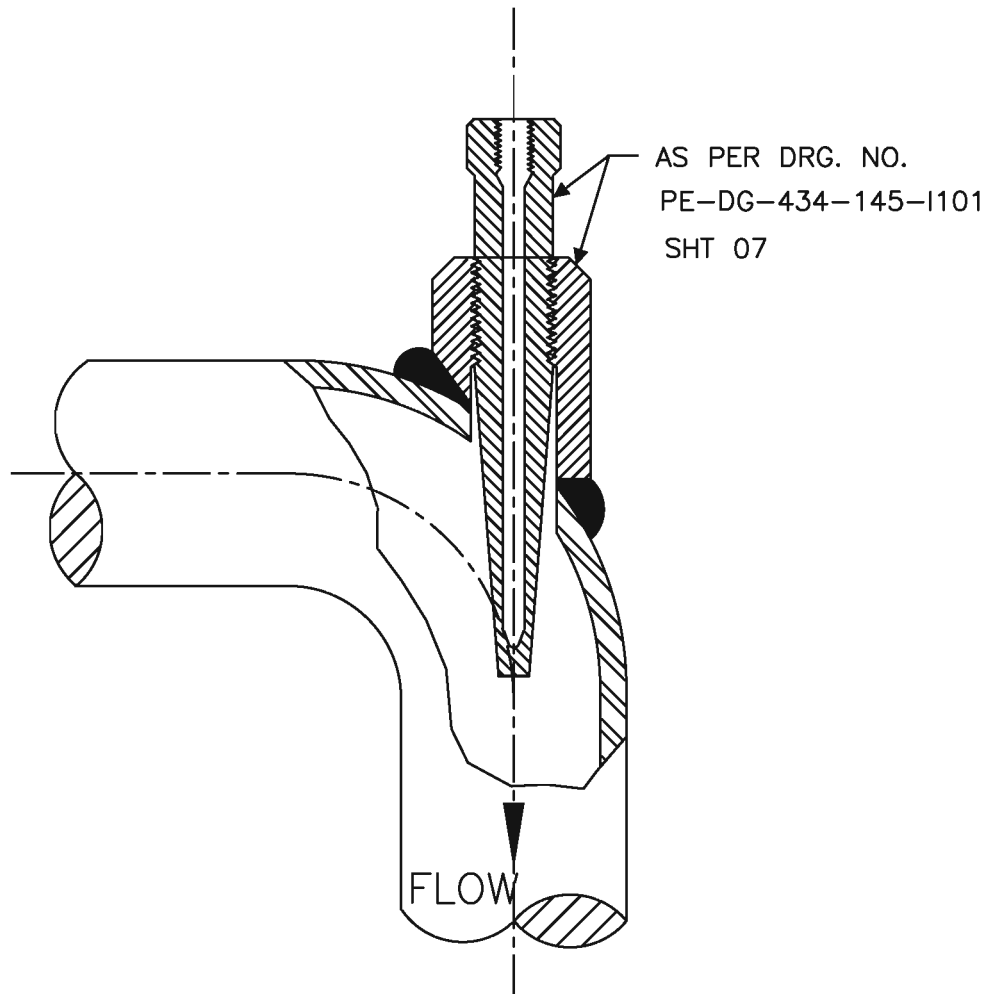
THERMOWELL INSTALLATION

DRG. NO.

PE-DG-434-145-I101

REV. 00

SH. 07 OF 08 SHS.



NOTES :-

1. FLOW INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MINIMUM 3" LINE SIZE. THIS DETAIL IS APPLICABLE FOR THERMOWELL INSTALLATION IN BEND PIPES.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF ELBOW FORM (AS SHOWN) OF 3" SIZE SHALL BE USED.
3. ELBOW EXPANDER SECTION IN HORIZONTAL PLANE TO BE USED FOR LIQUID SERVICE. FOR STEAM SERVICES EXPANDER SECTION TO BE USED IN VERTICAL PLANE.



TITLE :

**THERMOWELL INSTALLATION
(IN BEND PIPES)**

DRG. NO.

PE-DG-434-145-I101

REV. 00

SH. 08 OF 08 SHS.

SUB-SECTION – IIIC-10

TYPE TEST REQUIREMENTS

EPC PACKAGE FOR
PATRATU SUPER THERMAL POWER STATION EXPANSION
PHASE –I (3X 800MW)

TECHNICAL SPECIFICATION
SECTION-VI
BID DOC. NO.: CS:9585-001-2

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.00.00	TYPE TEST REQUIREMENTS			
1.01.00	General Requirements			
1.01.01	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. If the bidder proposes a different standard/code from that indicated at table 3.00.00, same is acceptable provided the equivalence of the proposed standard is established by the bidder. 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. (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. (b) For the rest, submission of type test results and certificate shall be acceptable provided. i. The same has been carried out by the Bidder/ sub-vendor on exactly the same model /rating of equipment. ii. There has been no change in the components from the offered equipment & tested equipment. iii. The test has been carried out as per the latest standards alongwith amendments as on the date of Bid opening. (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.			
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 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.			
1.01.05	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.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-10 TYPE TEST REQUIREMENTS	PAGE 1 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
2.00.00 2.01.00	SPECIAL REQUIREMENT FOR SOLID STATE EQUIPMENTS/ SYSTEMS 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: i) Surge Withstand Capability (SWC) for Solid State Equipments/ Systems 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. 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. Test listed at item no. v, vi, vii, above are applicable for electronic cards only as defined under item (i) above.		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)	TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-10 TYPE TEST REQUIREMENTS	PAGE 2 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS						एनटीपीसी NTPC
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	Transducers	As per standard (col 4)	IEC-60688, IS12784	No	Yes	
	3	Thermocouple	Degree of protection test	IS-13947	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	No	
	7	Dust emission monitor	Degree of protection test	IS-13947	No	Yes	
	8	Instrumentation Cables Twisted & Shielded*					
		-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 mass	VDE 0472	No	Yes	
			Ageing in air ovens**	VDE 0472	No	Yes	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)			TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2		SUB-SECTION-IIIC-10 TYPE TEST REQUIREMENTS		PAGE 3 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS					एनटीपीसी NTPC
		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 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	
		Colour fastness to water	IS-5831	No	Yes	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2		SUB-SECTION-IIIC-10 TYPE TEST REQUIREMENTS		PAGE 4 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS					एनटीपीसी NTPC
		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 Trans- actions	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	
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2		SUB-SECTION-IIIC-10 TYPE TEST REQUIREMENTS		PAGE 5 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS				
	* 1.0 All cables to be supplied shall be of type tested quality. 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. 2.0 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 either in an independent laboratory or at manufacturer's works in presence of Owner's representative under this contract free of cost to the Owner and submit the reports for approval. **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				
9	DC Power Supply System (Applicable for each model and rating)				
	1)The Type Test reports for offered rectifier module and the controller module irrespective of the rectifier bank shall be acceptable				
	Surge Withstand Capability(SWC)	ANSI 37.90.1, No IEEE-472,EN 61000-4-12	Yes		
	Dry Heat Test	IEC-68-2-2 or No equivalent	Yes		
	Damp Heat test	IEC-68-2-3 or No equivalent	Yes		
	Vibration test	IEC68-2-6 or No equivalent	Yes		
	Electrostatic discharge test	EN 61000-4-2 No orr equivalent	Yes		
	Radio frequency immunity test	EN-61000-4-3 No orr equivalent	Yes		
	Electromagnetici field immunity	EN 61000-4-3 No orr equivalent	Yes		
	Degree of Protection	IS-13947 or No equivalent	Yes		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2		SUB-SECTION-IIIC-10 TYPE TEST REQUIREMENTS	PAGE 6 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC				
	10 Battery ## As per standard (col 4) IS-10918 (Ni-Cd Batteries) No Yes IS-1652 (Lead Acid Plante Batteries) No Yes 11 NOT APPLICABLE 12 UPS (Applicable for each model and rating) 1) Type Test reports of same series of UPS with similar PCB's cards and controllers as the target UPS system shall be acceptable. 2) For Dry heat, Damp heat and vibration, the tests conducted on individual PCB's shall be acceptable. Surge Withstand Capability(SWC) ANSI 37.90.1, IEEE-472,EN 61000-4-12 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 Electrostatic discharge test EN 61000-4-2 or equivalent No Yes Radio frequency immunity test EN-61000-4-3 or equivalent No Yes Electromagnetic field immunity EN 61000-4-3 or equivalent No Yes Degree of protection test IS-13947 No Yes Fuse Clearing Capability Approved procedure No Yes Short Circuit current capability IEC 60146-2 No Yes				
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)	TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2	SUB-SECTION-IIIC-10 TYPE TEST REQUIREMENTS	PAGE 7 OF 9		

CLAUSE NO.	TECHNICAL REQUIREMENTS						
	13	Voltage Stabilisers	Over Load Test	Approved procedure	No	Yes	
			Temp rise test without redundant fans	Approved procedure	No	Yes	
	14	Public Address System					
		- Amplifiers	As per standard (col 4)	IS 9302, Part-II	No	Yes	
		Microphones	As per standard (col 4)	IS 9302, Part-III IS 15482:2004/ IEC 61842(2002)	No	Yes	
		Loudspeaker	As per standard (col 4)	IS 9302, Part-IV	No	Yes	
	15	LIE / LIR	Degree of protection test	IS-13947	No	Yes	
	16	Flue analyzers	gas Degree of protection test	IS-13947	No	Yes	
	17	Master Clock	Functional test	As per approved procedure	No	Yes	
	18	CJC Box	Degree Of protection test	IS-13947	No	Yes	
19	Junction Box	Degree Of protection Test	IS-13947	No	Yes		
20	OPC Access Data Server, Data Exchange & Server	OPC Compliance Testing		No	Yes (Self certification is also		
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)			TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2		SUB-SECTION-IIIC-10 TYPE TEST REQUIREMENTS	PAGE 8 OF 9	

CLAUSE NO.	TECHNICAL REQUIREMENTS						एनटीपीसी NTPC
	Historical Data Access Server acceptable) 21 Conductivity Type Switch Level Degree of protection test IS-2147 No No 22 Local Gauges Degree of protection test IS-2147 No No 23 Process actuated Switches Degree of protection test IS-2147 No No 24 Control Valves CV test ISA 75.02& 75.11 No Yes 25 PLCs As per standard (Col 4) IEC 1131 No No 26 Flow Nozzle Orifice plates Calibration ASME PTC BS 1042 No Yes ## The contractor shall submit for Employers approval the reports of all the type test as per latest IS-10918 carried out within last ten years from the date of Bid opening and the test(s) should have been either conducted at an independent laboratory or in presence / owners representative. The complete type test reports shall be for any rating of Battery in a particular group based on plate dimensions being manufactured by supplier. Note: Type Tests are to be conducted only for the items, which are being supplied as a part of this Package.						
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X 800MW)		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS:9585-001-2		SUB-SECTION-IIIC-10 TYPE TEST REQUIREMENTS		PAGE 9 OF 9	

PROVENESS CRITERIA

PROVENESS CRITERIA

1. Measuring instruments (primary & secondary), PLC, HMI, SWAS equipment offered for this package shall have at least one year's satisfactory operation in one power station having unit rating of 200 MW or above.
2. The 24 V DC modular charger offered for this package shall have at least one year's satisfactory operation in any industry or telecommunication application with a rating of 500 A or above.
3. The UPS system offered for this project, shall have atleast one(1) year's satisfactory operation, in one(1) power station for a rating of 105 KVA or above.
4. The Bidder should have carried out Engineering of Control and Instrumentation System of the complete plant including offsite plants of at least one (1) unit of a coal fired power station having unit rating 200 MW or above which is in successful operation for a period of not less than one (1) year. In case the Bidder does not have the engineering experience of the complete plant as described above, then the Bidder shall get the Control and Instrumentation engineering of the remaining plant area (s) done through any of its sub vendor(s) / supplier(s) or through Engineering firm(s) who meets the above requirement for the respective plant area(s).
5. Engineering referred in Para 4 above shall include the followings as a minimum.
 - a. Preparation of basic logic / loop diagrams (not just the implementations), I/O List, Drive list, Instrument list etc for each of the plant areas of the complete plant including offsite systems based upon Flow schemes / Write ups by the OEM (s)
 - b. Engineering of power supply system for DDCMIS, Process connection and piping, SWAS, Control Valves.
 - c. Instrumentation, cable engineering including preparation of Interconnection Cable Diagram, Cable schedule etc.

Documents in support of the above shall be submitted along with the Bid.

PROVENESS CRITERIA

5.00.00 INSTRUMENTS (PRIMARY & SECONDARY)

(i) Type of Instrument

(ii) Make / Model

(iii) Name of Power Station
(Location & Address)

(iv) Unit Size (MW)

(v) Commissioning date

Whether above instruments have
atleast one (1) year satisfactory
operation
in one (1) power station having
unit rating of 200 MW or above.

Yes/No

(vi) Client's certificate attached

Yes/No

6.00.00 24 V DC MODULAR CHARGER

(i)	Make/Model	
(ii)	Client Name & Address	
(iii)	Name of Industry (Power Gen Station/Telecommunication/Others)	
(iv)	Rating in Amps	
(v)	Commission Date	
(vi)	Whether above system have atleast one (1) year satisfactory operation in any industry or telecommunication application with a rating of 500A or above	Yes/No
(vii)	Client's certificate Attached	Yes/No

7.00.00 UPS SYSTEM

(i)	Make/Model	
(ii)	Name of Power Station (Location & Address)	
(iii)	Rating of UPS (phase, kVA)	
(iv)	Commission Date	
(v)	Whether above UPS have atleast one (1) year satisfactory operation in one (1) power station for a rating of Single Phase 105 KVA or above	Yes/No
(vi)	Client's certificate Attached	Yes/No

KKS PHILOSOPHY



DOCUMENT TITLE

KKS NUMBERING PHILOSOPHY

3 x 800 MW PVUNL PATRATU TPP PHASE-I

KKS NUMBERING PHILOSOPHY

For identifying (tagging) an instrument / equipment in Power plant KKS numbering scheme is used. The purpose is to assign a unique number to every equipment in the power plant. For C&I equipment unique number are to be provided up to the signal level so that a unique number Input / Output exist in DCS for every signal.

Normally KKS number is a 10 digit alpha-numeric code and is typically split into the following:

X	X	X	A	A	Y	Y	B	B	B

First three digits indicate the Sub-System. The Code for the major system are given as per **Annexure-1**.

Fourth and Fifth digits are the **Numerical Keys at System Code Level** and used to distinguish between main systems having same Alpha Codes.

Sixth and Seventh digits are the **Equipment / Apparatus / Measuring Circuit Code**. The code of various Equipment / Apparatus / Measuring Circuit is shown in **Annexure-2**

Eight, Nine and tenth digits are the **Numerical Keys at Equipment / Apparatus / Measuring Circuit Code** and used to distinguish between various instruments in the same sub-group. Numerical keys at System / Equipment / Apparatus / Measuring Circuit is shown in **Annexure-3**.

	DOCUMENT TITLE KKS NUMBERING PHILOSOPHY
	3 x 800 MW PVUNL PATRATU TPP PHASE-I

ANNEXURE-1

List of System / Sub-System Codes used in Power Plant:

- 1) Mill Reject Handling System: EUA

ANNEXURE-2

Standard Equipment Codes:

AA	Valves including drives, also hand operated
AB	Seclusions, Lock, Gates, Doors
AC	Heat Exchanger
AE	Turning, Driving, Lifting equipment
AF	Continuous conveyors, Feeders
AG	Generator Units
AH	Heating and Cooling Units
AK	Pressing and Packaging equipment
AM	Mixer, Stirrer
AN	Blower, Air Pumps / Fans, Compressor Units
AP	Pump Units
AT	Purification, Drying, Filter
AV	Combustion Equipment e.g. grates

Standard Apparatus Codes:

BB	Vessels and Tank
BF	Foundation
BG	Boiler Heating Surfaces
BN	Injector, Ejector
BP	Flow and throughput limitation equipment (Orifice)
BQ	Holders, Carrying Equipment, Support
BR	Piping, Ducts, Chutes, Compensator
BS	Sound Absorber
BU	Insulations, Sheatings

Standard Measuring Circuits Codes:

CD	Density
CE	Electrical Quantities
CF	Flow, throughput
CG	Distance, Length, Position
CK	Time
CL	Level

	DOCUMENT TITLE	
	KKS NUMBERING PHILOSOPHY	
	3 x 800 MW PVUNL PATRATU TPP PHASE-I	

CM	Humidity
CQ	Analysis (SWAS)
CS	Speed, Velocity, Frequency
CT	Temperature
CY	Vibration, Expansion

ANNEXURE-3

Numerical Keys

A) Numerical Keys at System Code Level

i) Use 10, 20, 30... To distinguish between main systems having same Alpha Codes. Examples:

a) Main Steam (Left) and Main Steam (Right)

b) BFP – A/B/C

c) ID Fan – A/B, FD Fan A/B, AH – A/B

ii) For branch off from main system path having code say 10, keep the same alpha code and use 11, 12, 13 etc. Similarly for other branch off from main system path having code say 20, keep the same alpha code and use 21, 22, 23 etc and shall carry on further in the same way.

iii) If the branch off from main system / sub system path is used for some other system, where different alpha codes can be applied, then in that case the said branch line will be designated by the alpha codes of the system to which it is providing the input.

B) Numerical keys at Equipment Code level:

There are three numerical keys available for each type of equipment code. Following has been agreed upon considering present practice, better flexibility and ease in sorting.

i) Valves and Dampers --- Equipment Code – AA

		<u>N1</u>	<u>N2 N3</u>
Motorised (<i>on/off duty</i>)	-	0	01 to 50
Motorised (<i>inching duty</i>)	-	0	51 to 99
Pneumatic (Control)	-	1	01 to 50
Motorised (<i>thyrestor Control</i>)	-	1	51 to 99
Sol. Operated	-	2	01 to 99
(Open / Close duty (Valves, NRVs, Gate)			
Hydraulic	-	3	01 to 99

	DOCUMENT TITLE			
	KKS NUMBERING PHILOSOPHY			
	3 x 800 MW PVUNL PATRATU TPP PHASE-I			
	NRV (Without actuation) Manual Manual Relief & Safety Valves Reserve Reserve	- - - - - -	4 5 6 7 8 9	01 to 99 01 to 99 01 to 99 01 to 99 01 to 99 01 to 99
ii) Field Instruments	Field Transmitters & Analog Signals Field Switches & Binary Signals PG Test Point Gauges Automatic Turbine Tester (ATT)-HWR (Reserved for protection Signals used by Hardwar)	- - - - - -	0 1 4 5 2	01 to 99 00 to 99 00 to 99 00 to 99 00 to 99
Example of Numerical Key Usage:	In line with the philosophy adopted for Valves / Dampers /instruments etc. pumps and fans in the main systems (having different system code) can be numbered as AP/N100 and as AP/N101, 102, ... Where system code is same.			



TITLE :
3X800MW PATRATU TPP PHASE-1

**TECHNICAL SPECIFICATION FOR HYDROGEN
GENERATION PLANT**

SPECIFICATION NO. PE-TS-434-168-A001

SECTION : III

SUB-SECTION:

REV. NO. 00

DATE :

SECTION – III



TITLE : 3X800MW PATRATU TPP PHASE-1	SPECIFICATION NO. PE-TS-434-168-A001	
	SECTION : III	
	SUB-SECTION:	
	REV. NO. 00	DATE :

**TECHNICAL SPECIFICATION FOR HYDROGEN
GENERATION PLANT**

SCHEDULE OF PRE-BID CLARIFICATION

All clarification from the Technical Specification shall be filled in by the BIDDER clause by clause in this format only.

VOLUME	SECTION	CLAUSE NO.	PAGE NO.	SPECIFICATION REQUIREMENT	CLARIFICATION	REASONS FOR CLARIFICATION

	TITLE :		SPECIFICATION NO. PE-TS-434-168-A001
	3X800MW PATRATU TPP PHASE-1		SECTION : III
	TECHNICAL SPECIFICATION FOR HYDROGEN GENERATION PLANT		SUB-SECTION:
		REV. NO. 00	DATE :

COMPLIANCE CUM CONFIRMATION SCHEDULE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate and furnishing same with the offer:

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions/ deviations with regard to same.
2. QP/ test procedures shall be submitted in the event of order based on the guidelines given in the specification & QP enclosed therein.
3. QP will be subject to BHEL/Customer approval in the event of order & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc.
The charges for 3rd party inspection (Lloyds, TUV or equivalent) for imported components shall be included in the base price of the equipment by the bidder.
4. All drawings/data – sheets etc. to be submitted during contract shall be subject to BHEL/Customer review/ approval. GA drawings, as submitted with offer at tender stage are for reference purpose only and shall be subject to approval during contract stage.
5. There are no other deviations with respect to specification other than those furnished in the 'Schedule of Deviations'.
6. The offered materials shall be either equivalent or superior to those specified. Also for components where material is not specified it shall be suitable for intended duty, materials shall be subject to approval in the event of order.
7. The commissioning spares (if any) are supplied on 'As Required Basis' & prices for same included in the base price (If bidders reply to this is "No commissioning spares are required" and if some spares are actually required during commissioning same shall be supplied by bidder without any cost to BHEL).
8. All sub vendors shall be subject to BHEL/CUSTOMER approval.
9. Any special tools & tackles, if required, shall be in bidder's scope.
10. Performance guarantee test parameters shall stand valid till the satisfactory completion of Performance guarantee test and its acceptance by BHEL/Customer.
11. Prices for recommended spares (if any) for three year operation shall be furnished separately and not to be included in the base price.



TITLE :
3X800MW PATRATU TPP PHASE-1

**TECHNICAL SPECIFICATION FOR HYDROGEN
GENERATION PLANT**

SPECIFICATION NO. PE-TS-434-168-A001

SECTION : III

SUB-SECTION:

REV. NO. 00

DATE :

DECLARATIONS

I certify that all the technical data and information pertaining to this specification are correct and are true representation of the equipment/system covered by our format proposal number Dated and there is no deviation to the specification.

I hereby certify that I am duly authorized representative of the Bidder's company whose name appears above my signature.

Bidders Company Name

Authorized representative's Signature

Name

Bidder's Name

The bidder hereby agrees to fully comply with the requirements and intent of this specification for the price indicated.

SCHEDULE OF DEVIATIONS WITH COST OF WITHDRAWAL



PROJECT:- 3X800MW PATRATU TPP PHASE-1

HYDROGEN GENERATION PLANT

TENDER ENQUIRY REFERENCE:-

NAME OF VENDOR:-

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF withdrawal OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF withdrawal OF DEVIATION IS APPLICABLE	NATURE OF COST OF withdrawal OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION

TECHNICAL DEVIATIONS

COMMERCIAL DEVIATIONS

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	DESIGNATIONS	SIGN & DATE

NOTES:

1. For self manufactured items of bidder, cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
2. For directly dispatchable items, cost of withdrawal of deviation will be applicable on the basic price including taxes, duties & freight.
3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.
4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
5. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.
6. Bidder shall furnish price copy of above format along with price bid.
7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.
9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
12. Cost of withdrawal is to be given separately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.
13. In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.
14. In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.