

BHARTIYA RAIL BIJLEE COMPANY LTD.


4X250 MW, NABINAGAR THERMAL POWER PLANT

**TECHNICAL SPECIFICATION
FOR
HYDROGEN GENERATION PLANT**

**SPECIFICATION NO: PE-TS-300-168-A000
VOLUME -IIB**




**BHARAT HEAVY ELECTRICALS LTD.
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI**

	TITLE: TECHNICAL SPECIFICATION FOR HYDROGEN GENERATION PLANT 4X250 MW, NABINAGAR THERMAL POWER PLANT	SPEC. NO. PE-TS-300-168-A000	
		VOLUME II-B	
		SECTION	
		REV. NO. 0	DATE:
		SHEET	OF


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SECTION - A SCOPE OF ENQUIRY

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1.0 SCOPE OF ENQUIRY

This specification is intended to cover design, engineering, manufacture, inspection, testing at manufacturer's works, supply/delivery duly packed at site including freight, unloading, storage and handling at site, erection and commissioning, trial run at site, PG test, obtaining CCE approval and plant handing over to customer etc. inclusive of all prevailing taxes, duties and other levies of HYDROGEN GENERATION PLANT complete with all accessories including start up, mandatory spares and commissioning spares as required for **4X250 MW, NABINAGAR THERMAL POWER PLANT**

- 1.2 Items though not specifically mentioned but needed to make the system complete as stipulated under these specifications are also to be furnished unless otherwise specifically excluded.
- 1.3 It is not the intent to specify all the details of the design & manufacture. However, the equipment shall be of proven design and conform in all respect to high standard of design, engineering & workmanship and shall be capable of performing the required duties in a manner acceptable to Engineer / Owner, who will interpret the meaning of drawing & the specification & shall be entitled to reject any work or material, which is not in full accordance herewith.
- 1.4 In case of any deviation, the Bidder shall indicate the same clause by clause in the deviation schedule. In the absence of the same it will be construed that the bid conforms strictly to the specification.
- 1.5 General terms & conditions, instructions to the tenderer & other attachments referred to elsewhere made part of this specification.
- 1.6 In case of any conflict between Section-C and Section-D, Section-C of the technical specification shall prevail over section D.
- 1.7 In case of any data/requirement stipulated in the drawings but not in the specification and vice-versa, such data /requirement shall be deemed to be contained in the both. Contradictions between drawings and specifications, if any, shall be brought to the attention of the purchaser/consultant by the bidder and the correct requirement shall be obtained.
- 1.8 In the event of any conflict between the various sections of the specification, bidder shall obtain necessary confirmation in writing from the purchaser.

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SECTION – B

PROJECT INFORMATION

CLAUSE NO.	PROJECT INFORMATION
<p>3.00.00</p> <p>LAND REQUIREMENT</p> <p>Total area of land acquired for the project : 1700 Acres</p> <p>Any other information : Approximately 1700 acres of land has been identified near Dhundhua village for the Plant, Township and Ash Disposal Area. In-principle commitment for the availability of land for Plant, Township and Ash Disposal Area has been obtained from Revenue Department, Govt. of Bihar vide letter dated 29.3.2003. Further, Central Coalfields Ltd. (CCL) vide their letter dated 29.05.03 have indicated that Central Mine Planning & Design Institute Ltd. (CMPDI) have confirmed that plant location along with its other allied infrastructure are not coming on coal bearing area.</p> <p>4.00.00</p> <p>WATER</p> <p>Nearest Water Source :The project site is located near the river Sone which is the only source of water for the project. Therefore, the make up water requirement for the project is proposed to be drawn from the pondage created by Indrapuri Barrage, which is about 3 kms. from the proposed site.</p> <p>Proposed water requirement for the Stage : 60 Cusec</p> <p>Proposed source/ arrangement to meet the water requirement :The project site is located near the river Sone which is the only source of water for the project. Therefore, the make up water requirement for the project is proposed to be drawn from the pondage created by Indrapuri Barrage, which is about 3 kms. from the proposed site. The make up water requirement for the project operating on cooling towers is about 4300 cubic m./hr with ash water recirculation system and about 5900 cubic m./hr. with once through ash water system. Water Resource Department, Govt. of Bihar, accorded in- principle clearance of 60 cusecs of consumptive water from upstream of Indrapuri Barrage vide their letter dated 06.03.03.</p> <p>Any other information: :</p>	
Page 2 of 8	<div>Sub-Section - I Project Synopsis</div> <div>TECHNICAL SPECIFICATIONS SECTION VI, PART-A</div> <div>Bid Doc. No.. CS-0270-110-2</div> <div>NABINAGAR THERMAL POWER PROJECT (4 x 250) STEAM TURBINE GENERATOR PACKAGE</div>

5

CLAUSE NO.	PROJECT INFORMATION			
5.00.00	RAILWAY SIDING For bringing the equipment and material to the power house through rail, railway siding is proposed to be constructed from nearest railway station.			
6.00.00	METEOROLOGICAL DATA Meteorological data of the nearest observatory Dehri station is enclosed as Annexure-II to this subsection.			
7.00.00	PLANT WATER SCHEME The plant water scheme shall be referred in the relevant Tender Drawings.			
7.01.00	Condenser Cooling (CW) Water System It is proposed to provide recirculating type CW system with induced draft type cooling towers.			
7.02.00	Equipment Cooling Water (ECW) System (Unit & Station Auxiliaries) For scheme of Equipment Cooling Water System refer relevant tender drawings.			
8.00.00	ASH WATER SYSTEM It is proposed to provide ash water re-circulation system. Decanted water from ash pond shall be led to the plant area by using pumps and the same shall be conveyed through carbon steel pipes from ash dyke to plant area. . This water will be used further in the ash handling system. Blow down of ash water from the system shall be carried out to maintain the system scale free Normal make up to the ash water system shall be from CW blow down water. However provision shall also be kept for operating ash water system on "Once Through" mode During "Once Through" mode operation, additional makeup shall be met from the plant raw water supply. Provision to supply treated plant effluent from central monitoring basin to ash handling shall also be kept.			
9.00.00	OTHER MISCELLANEOUS WATER SYSTEMS The quality of Clarified water filtered (potable) water and DM water is given in the enclosed Annexure-I to this Sub-section.			
10.00.00	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 in the Technical Specification on Civil Works.			
11.00.00	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 the Technical Specification on Civil Works.			
NABINAGAR THERMAL POWER PROJECT (4 x 250) STEAM TURBINE GENERATOR PACKAGE		Bid Doc. No.: CS-0270-110-2	TECHNICAL SPECIFICATIONS SECTION VI, PART-A	Sub-Section - I Project Synopsis
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जलवायवी सारणी
CLIMATOLOGICAL TABLE

STATION: Delhi

[illegible]

PROJECT INFORMATION


जलवायवी सारणी
CLIMATOLOGICAL TABLE

CLIMATOLOGICAL TABLE

स्थान : देहरादून	देश :	उचाई : 107 मीटर	समुद्र तल से उचाई : 107 METRES
STATION : Dehra	COUNTRY :	ALTITUDE : 107 M	HEIGHT ABOVE M. S. L. : 107 METRES
LONGITUDE : 78° 55' E LATITUDE : 26° 55' N			
1951 से 1980 तक के डेटा पर आधारित BASED ON OBSERVATIONS FROM 1951 TO 1980			


वायु तापमान										वर्षा	
महीना	वायु तापमान				वर्षा		वर्षा		वर्षा		
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	TITLE: TECHNICAL SPECIFICATION FOR HYDROGEN GENERATION PLANT 4X250 MW, NABINAGAR THERMAL POWER PLANT	SPEC. NO. PE-TS-300-168-A000	
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SECTION – C

SPECIFIC TECHNICAL REQUIREMENT

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SECTION – C1

**EQUIPMENT / SYSTEMS TO BE SUPPLIED
ALONG WITH
DESIGN ENGINEERING REQUIREMENTS.**

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GENERAL:-

This specification is intended to cover design, engineering, manufacture, inspection, testing at manufacturer's works, supply/delivery duly packed at site including freight, unloading, storage and handling at site, erection and commissioning, trial run at site, PG test, obtaining CCE approval and plant handing over to customer etc. inclusive of all prevailing taxes, duties and other levies required for **4X250 MW, NABINAGAR THERMAL POWER PLANT:-**

Note1:- Bidder to note that the technical specification is prepared considering unipolar and bipolar design both. So the equipment and mandatory spares as applicable for Unipolar / Bipolar design as per manufacturer standard practice shall be supplied.

A) Major Mechanical scope:-

- Two streams of electrolyzers working in parallel (each of capacity minimum 4.5 Nm³/hr.).
- Three (3) numbers of hydrogen gas compressors and drives (each of minimum 5.6 Nm³/hr.) with cell purging system, mixing tank, DM tank, pumps to handle electrolyte and its filters, gas washing system, two gas holders each of minimum capacity 10 m³ for unipolar design.
- De-oxy units, coolers, hydrogen gas purification system, filling manifold, piping fitting, valves, 8 number empty hydrogen cylinders, 8 numbers empty nitrogen cylinders complete with required instrumentation and other items as per P&ID for the hydrogen generation plant enclosed with this technical specification.
- Bidder shall include vacuum pump and high-pressure cylinder testing apparatus along with all accessories for testing cylinders.
- Bidder to note that the instrument air / service air shall **not** be provided by customer. If instrument / service air is required by bidder for any of his equipment, bidder shall include 2X100% capacity air compressors and 2X100% capacity air drying plant to meet the requirement of hydrogen generation plant.
- Bidder to include the Ventilation Requirement for **hazardous and non-hazardous area including toilets** in his scope for the H2 Plant building as per the requirement specified in the clause number 4.00.00, section C2 of technical specification. Bidder shall also include in his scope window Air-conditioners for his control panels etc. Bidder to specify the same in his offer.
- Feed water / Cooling water:**
Bidder shall be given DM water for hydrogen generation and cooling purpose (at the rate of 40 liter/hr at 10 MWC) at one point near hydrogen generation plant building. Further distribution to cells, compressor & other auxiliaries within the plant shall be in bidder's scope. Bidder to include close loop cooling using passivated DM as make-up water. Bidder shall supply the equipments required for passivation of the DM water for making it suitable for bidder's equipments. Bidder shall supply necessary arrangement like chillers etc. for passivated DM water cooling to meet system requirement.
- Bidder shall include in his scope necessary support/platform /ladder/hanger /anchor bolts as required for satisfactory erection / commissioning & operation of plant shall be provided by bidder.
- Bidder shall include in his scope all hydrogen generation plant pipes and conduit support. All drains shall be terminated at point in hydrogen generation plant building.
- Bidder shall also provide connection, isolation device, manifold, piping etc. for N2 gas connection to cell system for purging.

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11. Bidder to note that N2 gas required for purging the system during commissioning/PG test/trial operation etc. till handing over the plant to NTPC shall be arranged by bidder.
12. Bidder shall include in his scope one lot of mandatory spares as per list enclosed as section C5 of technical specification.
13. 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.
14. Bidder shall guarantee that the equipment offered shall meet the rating and performance requirements for successful running of hydrogen Generation plant.

B) Electrical scope:-


1. The scope of electrical works, equipment and services shall be as per table for electrical scope between BHEL and vendor enclosed in annexure – 2, section C3 of technical specification.
2. **Constant speed Sq. cage type Electric motor shall be suitable for group IIC of IS 2148 which is equivalent to Class-I Div.II of NEC.**
3. The other electrical design requirement shall be as specified in section D2 of technical specification.

C) Control and instrumentation scope:-

1. **All necessary instruments such as transmitters/temperature elements/sensors/switches/gauges etc. shall be provided for safe, efficient & reliable operation and maintenance of the H2 generation plant. All instrument devices shall be provided with explosion proof enclosure as described in NEC (USA) Article 500, Class – I, Div. I or to provide suitable type zener barriers of standard approved make meeting the requirements as approved by chief controller of explosives, India and other statutory authorities.**
2. The control of hydrogen generation plant shall be dual processor based PLC system, PLC unit shall be provided with two processors (main processing unit with memories) one for normal operation and one as cold standby.
3. The PLC system shall be provided with necessary interface hardware and software, for dual fiber optic connectivity and interconnection with station wide LAN (In employer's scope) for two-way transfer of signal for information sharing only of hydrogen generation plant. The plant information shall be made through ether net link following TCP / IP standard. The system shall be OPC compliant. The dual fiber optic communication cable between bidders control panels and employer's DDCMIS is excluded from bidder's scope.
4. The other control and instrumentation design requirement shall be as specified in section D3 of technical specification.

D) Civil scope:-

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

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E) COMMISSIONING SPARES

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

F) RECOMMENDED SPARES

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

G) QUALITY ASSURANCE PLANS

Bidder to note the QP requirement shall be inline with the section D4 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.

H) SUB VENDOR:-

Bidder to note that all the sub-vendors shall be in line with the sub vendor list approved by NTPC for any recently executed NTPC project. In case of newly proposed sub vendor list, it shall be subjected to approval from BHEL/customer during detailed without any commercial or delivery implication to BHEL.

I) PG TEST:-

Bidder shall perform the guarantee parameters as per the section C6 of technical specification requirement to the satisfaction of Owner. The exact modalities of verifying guarantee for the parameters indicated in the specification shall be finally as agreed with the Owner during detailed engineering & mutually agreed.

The Bidder shall arrange all the monitoring gadgets / instruments / equipment required for performing guarantee parameters (returnable after PG test). Site facility as available or as extended by Owner shall only be provided.


J) TERMINAL POINTS (Refer P & I Diagram enclosed)

Feed water / Cooling water:

TP1:- Feed water / Cooling water (Refer annexure – 1, section C3 for the feed water analysis):- Bidder to note that the DM quality feed water pipe of 40 NB size (flow rate as required at 10 MWC) shall be terminated at one point (10 meter from hydrogen generation plant building) for hydrogen generation and cooling of cells, compressors and other auxiliaries. Further distribution to cell and other auxiliaries within the hydrogen generation plant shall be in bidder's scope.

Note:- Temperature of feed water / cooling water at TP1 shall be as per ambient conditions

TP2, Drains:- All drains shall be terminated at one point by bidder.

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- K) **Painting:** Bidder to note that hydrogen generation plant painting for the imported items shall be equivalent or superior than the painting specification enclosed with the section C4 of technical specification.
The painting of the indigenously supplied equipments shall be as per the section C4 of technical specification only.
The color-coding for hydrogen generation plant shall be decided during detailed engineering.

L) **DRAWINGS/DOCUMENTATION**

Drawing/documents requirement (No. of hard copies/CD-ROM/floppies) shall be as stated in annexure – 3, section C3 of technical specification.


Bidder to note that all the drawings/documents including Process & instrumentation diagram, layout, piping, equipment data sheet, foundation drawing, control & instrumentation, general arrangement drawings, field quality plan, quality plan, erection drawings, O&M Manual, PG Test procedure, electrical single line diagram, plant control philosophy etc. as per document list enclosed in the specification shall be submitted for approval of BHEL/Owner during detailed engineering. In case any change is suggested by Owner to meet the system/specification requirement, the same shall be incorporated / carried-out without any commercial/delivery implication to the satisfaction of Owner/BHEL.

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

N) **POWER LOADING CRITERIA:-**

Bidder shall submit format for guaranteed power consumption in the format attached as annexure – 5, section C3 of technical specification, duly filled-in in all respects along with priced bid. The net differential loading amount (worked out in the following manner) will be added with respective bidder's total quoted price to derive the total price for evaluation. The consumption in KW quoted by the bidder in the format shall be loaded @ US \$ 2000.00 for each KW increase in total consumption from the lowest consumptions figure quoted by technically recommended bidders. In case the successful bidder fails to establish/ prove the guaranteed values of power consumption on actual performance testing at the manufacturing works/ site, penalty @ US \$ 3379.00 per KW increase in power consumption shall be levied.

Bidder to note that for evaluation and penalty 1/3 of power consumption quoted by bidder shall be used.

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SECTION – C2

TECHNICAL WRITE-UP FOR HYDROGEN GENERATION PLANT

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p style="text-align: center;">HYDROGEN GENERATION PLANT</p>		
1.00.00	<p>GENERAL PLANT DESIGN CRITERIA</p> <p>a.) To be designed for continuous, as well for as two shift or one shift operation.</p> <p>b.) The scheme shall be based on manufacturer's standard. Hydrogen generation plant offered can either be of unipolar design or bipolar design as per manufacturers standard practice.</p> <p>c.) Total Plant Capacity to be sized as follows:</p> <p style="margin-left: 40px;">Leakage rate per generator = "A" NM³/day</p> <p style="margin-left: 40px;">Requirement of one generator filling = "B" NM³.</p> <p style="margin-left: 40px;">Number of Units = C</p> <p style="margin-left: 40px;">Hydrogen generation plant Capacity = [C*1.5* A + B/30]/12 NM³/hr</p> <p>d.) The Plant capacity would be based on the Criteria detailed out above. However, total plant capacity in no case shall not be less than 9 NM³/hr with two streams of 50% Capacity each of minimum 4.5 NM³/hr.</p> <p>e.) Hydrogen purity to be maintained at gas manifolds 99.9%</p> <p>f.) Moisture content in hydrogen: - 0.05 gm/m³ (max.)</p> <p>g.) The Complete Hydrogen generation plant system, equipments, layout etc. shall be designed as per the Explosives Authority and the bidder shall obtain the approval from Chief controller of Explosives - India and other statutory authorities for the design and installation of the plant.</p> <p>h.) Description of various components of Hydrogen generation plant has been discussed below. Some of the components specified here in may not be applicable for bipolar design. For bipolar design, the same need not be supplied, if it is not applicable as per manufacturers standard practice.</p>		
2.00.00	<p>GENERAL OPERATIONAL CRITERIA/PHILOSOPHY</p> <p>a.) To be designed for Continuous duty.</p> <p>b.) To be designed for parallel operation of both streams.</p> <p>c.) Flexibility to operate electrolyser in part load.</p> <p>d.) Complete operation from remote control panel/OWS.</p> <p>e.) 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.</p> <p>f.) Set pressure to be maintained with help of back pressure regulation valve.</p>		
NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2	A-7: HYDROGEN GENERATION PLANT	PAGE 1 OF 6


CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>g.) Automatic operation of standby compressor as and when required.</p> <p>h.) To provide alarm & tripping of compressor based on suction conditions.</p>		
3.00.00	CONSTRUCTION DETAILS OF EQUIPMENT		
3.01.00	Electrolyser / Generator (as applicable) <p>a.) Cells in electrolyser/ generator shall be connected to each other. Further for Unipolar design, there shall be provision to isolate any one of them Cells in electrolyser . The Cells in electrolyser / generator shall be of corrosion resistant material.</p> <p>b.) The electrolyser/ generator 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.</p> <p>c.) All measuring instruments, controllers and control valves shall be provided.</p> <p>d.) Safety devices are to be provided on each collecting pipe to release gas pressure in case it goes above the limits.</p> <p>e.) To be designed so that it can be dismantled, cleaned, and reassembled easily.</p> <p>f.) Proper sealing shall be provided by the Bidder while crossing the wall to avoid any gas leakage to Rectifier Room.</p> <p>g.) Each electrolyser/ generator shall be fitted with the following instrumentation.</p> <p>(1.) In unipolar design one explosion proof temperature switch in each cell for electrolyser temperature high alarm on the control panel. In case of bipolar design one explosion proof temperature switch in each generator module for electrolyser temperature high alarm on the control panel.</p> <p>(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.</p> <p>(3.) One temperature gauge for local indication for electrolyte temperature.</p> <p>(4.) One off-line specific gravity measuring instrument.</p>		
3.02.00	Rectifier (if applicable) <p>Two nos, of rectifier (one for each electrolyser) to cater to the load of each of the electrolyse. The rectifier equipment shall be complete in all respects with air-cooled</p>		
NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2	A-7: HYDROGEN GENERATION PLANT	PAGE 2 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS
3.03.00	<p>rectifier transformer, thyristor converter, electronic control and annunciation, fillers choke etc mounted in suitable panels.</p> <p>Gas washing Tanks (if applicable)</p> <p>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.</p>
3.04.00	<p>Demineralised water tank</p> <p>a.) One number tank of Capacity adequate for 5 days normal requirement of hydrogen gas generation on continuous basis at rated capacity of 45 NM³/hr.</p> <p>b.) To be fitted with removable drain connections, level switches/ transmitter, level indicators etc.</p>
3.05.00	<p>Caustic solution mixing tank (if applicable)</p> <p>(i) Capacity - Suitable to fill one electrolyser</p> <p>(ii) Material - High Density PVC</p> <p>(iii) Accessories - Removable cover, motor operated pump, instrument as required</p> <p>(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.</p>
3.06.00	<p>Hydrogen gas Holders (for unipolar design)</p> <p>(i) Number Two (2) numbers (one for filling, one for supply to compressor)</p> <p>(ii) Capacity of each gas holder Minimum of 10 M³.</p> <p>(iii) Material IS-2062/2002 or equivalent</p> <p>(iv) To be designed for outdoor duty</p> <p>(v) To provided with two (2) Seal pots for each gas holders</p> <p>(vi) Accessories such as Wire rope, Counter weight, guide pulley required to suspend the gas holders, steel stairs four-way motorised valves, flame proof low & high level switches for interlock and control, float type level indicators, etc.</p> <p>vii) Venting of hydrogen shall be trough flame arrestor.</p>
<p>NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE</p>	<p>TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2</p> <p>A-7: HYDROGEN GENERATION PLANT</p> <p>PAGE 3 OF 6</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS					
3.07.00	De-oxy unit (if applicable)					
	Numbers	1 (To handle both the streams and capable to remove oxygen as impurity)				
	Accessories	Heater with temperature control device, gas cooler, filter, necessary instruments etc.				
3.08.00	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				
	(iii) Design Pressure delivery	150 kg/cm ² (g)				
	(iv) Type	Preferably Oil free, Piston or Diaphragm type.				
	(v) Piston type	Of proven design				
	(vi) Diaphragm type	Triple diaphragm failure detection system. The side and oil side diaphragms shall be of stainless steel.				
	(vii) Drive cage	Constant speed Sq. cage flame proof type Electric motor suitable for group-II-C location as per IS:2148 Clause-I Div.-I of NEC.				
	(viii) Activated carbon filters	2 x100% and required in case of oil lubricated compressor				
	(ix) All metal to metal joints shall be provided with "O" rings of suitable grade material.					
	(x) To provide auxiliaries such as built in relief valves, Pressure and temperature gauges after every compression stages, mechanical lubricator, built in automatic unloader devices, Water cooled inter coolers after every compression stage, flow switches, pressure gauges in coolant line, sight flow indicators in coolant line, V belt drive with pulleys, a transfer switch to allow operation of standby compressor automatically, suction filters, scrubber to remove any traces of entrapped electrolyte, separator and filters, suitable protection device to prevent suction of water from gas holders as a back-up to low level switch provided on the gas holders for compressor TRIP, Mist Eliminators One number on-line hydrogen purity analyser at the suction etc.					
	(xi) To make arrangement for continuously monitoring hydrogen purity before compressor and before filling of gas into cylinders and to provide suitable alarm and automatic tripping of plant in case, hydrogen purity falls below the preset level.					
<table><tr><td>NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE</td><td>TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2</td><td>A-7: HYDROGEN GENERATION PLANT</td><td>PAGE 4 OF 6</td></tr></table>			NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2	A-7: HYDROGEN GENERATION PLANT	PAGE 4 OF 6
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.09.00	Drying system for Hydrogen gas(if applicable) a.) To provide twin tower moisture separating columns of Regenerative design alongwith instruments. b.) To provide valves arrangement to suit operation of one Column & another under regeneration. The operation shall be automatic based on PLC/ microprocessor command.		
3.10.00	Back Pressure regulating valve a.) Spring loaded disc operated self actuating type back pressure regulating valve to maintain 150 kg/cm2 (g) pressure on the compressor discharge. b.) To be provided with accessories such as Pressure sensing element, controller etc.		
3.11.00	Cylinder Manifold a.) To provide one dual cylinder filling manifold, arranged for two banks of minimum four cylinders each. b.) To provide accessories such as Isolating valves, safety valves, Pressure gauges, pressure switch (To shut-off compressors beyond set pressure) "ON-LINE" Hydrogen purity analyser, trace oxygen analyser, moisture analyser at cylinder manifold, records of hydrogen purity and moisture content, & one number PORTABLE hydrogen gas purity testing kit.		
3.12.00	Flushing System		
3.12.01	To be provided with necessary connection with proper isolation devices, nitrogen cylinders, valves, manifolds piping etc to enable purging the system with nitrogen commissioning and each maintenance work.		
3.13.00	Hydrogen leak detection system:		
3.13.01	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.		
3.14.00	Air Compressors (If required) In case bidder's Hydrogen generation plant requires compressed air, 2X100% capacity air compressors need to be provided by the bidder. If Instrument quality compressed air is required, in such case 2X100% capacity air drying plant also needs to be provided.		
3.14.00	Piping a.) All Pipe to conform to ASA pressure piping code, and seam less type.		
NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2	A-7: HYDROGEN GENERATION PLANT PAGE 5 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS
4.00.00	<p>b.) All high pressure joints shall of ferrule/ welded construction.</p> <p>c.) All vents to be fitted with flame arrestor.</p> <p>d.) All high pressure drains to be terminated through H2 traps and all low pressure drains to be terminated through U-bends.</p> <p>e.) Cooling water pipe be minimum 80 NB size.</p> <p>VENTILATION SYSTEM</p> <p>a.) 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.</p> <p>b.) The air quantity of ventilation system shall be estimated based on minimum 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.</p> <p>c.) Bidder to provide louvers for fresh air supply for the building.</p> <p>d.) Bifurcated type of axial flow fans for exhausting air/fumes shall be provided for hydrogen generation plant area and shall be of flame proof construction with inlet and outlet dampers. However, ducts and all other parts like blades etc. shall be epoxy painted.</p>
5.00.00	<p>HYDROGEN AND CO2 GAS CYLINDERS N₂</p>
5.01.00	Adequate quantity of gas cylinders shall be supplied and installed as described in relevant Sub-Section Sub-Sections of technical specification.
6.00.00	Control and Instrumentation
6.01.01	<p>All necessary instruments such as transmitters/temperature elements / sensors / switches / gauges etc. shall be provided by the Contractor for safe, efficient & reliable operation and maintenance of the H2 generation plant. All instrument devices shall be provided with explosion proof enclosure as described in NEC (USA) Article 500, Class-I, Div.-I as specified in relevant Control and Instrumentation Sub-Section of Technical Specification. For further details refer to the requirements specified in control & instrumentation Sub-Section of Technical Specification. The control panel shall be microprocessor/ PLC based.</p>
7.00.00	PAINTING
7.01.00	All the Piping, Valves and Equipments of this system shall be protected against external corrosion by providing suitable painting as described elsewhere in the specification.
<p>NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE</p>	<p>TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2</p>
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ANNEXURES

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ANNEXURE - 1

ANALYSIS OF DM WATER TO BE USED FOR MAKE-UP WATER FOR HYDROGEN GENERATOR AND COOLING OF CELLS AND COMPRESSOR AFTER PASSIVATION

SL. NO.	Charachteristics	Value
1	Silica (Max)	0.02 ppm as SiO ₂
2	Iron as Fe	Nil
3	Total hardness	Nil
4	Ph value	6.8 to 7.2
5	Conductivity excluding the effects of free CO ₂ (Micro-mho/cm)	Not more than 0.1

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

ANNEXURE-1

PROJECT: NABINAGAR TPP (4X250 MW)

PACKAGE: HYDROGEN GENERATION PLANT (R0)

<u>S.NO</u>	<u>ITEM NO.</u>	<u>DETAILS</u>	<u>SCOPE SUPPLY</u>	<u>SCOPE E&C</u>	<u>REMARKS</u>
1	I	415V Switchgear	BHEL	BHEL	Any other control panel /distribution board required shall be provided by Vendor.
2	II	Local Push Button Station	BHEL	BHEL	Emergency push buttons (PB) for motor located near the motors. Any other type of (PB) required shall be indicated by the bidder.
3	III	Power cables, ordinary control cables and screened control cables between equipment supplied by vendor. Laying & termination of these cables at both of vendor equipment by vendor.	BHEL	Vendor	Any special purpose cable i.e. compensating, co-axial, prefab, MICC etc. required will be in bidders scope. Laying & termination of special cables at both end of equipment by vendor
4	IV	Power cables, ordinary control cables and screened control cables between equipment supplied by vendor and BHEL. Laying by BHEL & termination at vendor equipment by vendor.	BHEL	BHEL/ Vendor	
5	V	Lighting	BHEL	BHEL	
6	VI	Cable trays and accessories	BHEL	BHEL	Laying of cable trays between vendor equipments by vendor.
7	VII	Supporting system for cable trays	BHEL	BHEL	
8	VIII	Equipment earthing	BHEL	BHEL	
9	X	Motors	Vendor	Vendor	As per hazardous area classification
10	XI	a) Input cable schedules b) Cable interconnection detail (diagram) c) Cable block diagram	a,b,c by Vendor	-	Cable listing for control cables for vendor supplied equipment in the enclosed cable schedule format
11	XII	Input cable layout drawings	Vendor	-	Layout details between vendor supplied equipment by vendor
12	XIII	Cable glands and lugs for equipment supplied by vendor	Vendor	Vendor	

NOTE: SOFT COPY OF CABLE LISTING IN THE CABLE SCHEDULE FORMAT

All documents & drawings shall be in English and in metric units and in Soft form in addition to Hard Copies of Documents listed below shall be submitted


S.No	DESCRIPTION	NTPC-EC	NTECL-SITE	BHEL SITE	OTHERS (BHEL)	PEM (BHEL)
1	Master list of drawings / documents (duly indicating schedule of submission)	2 Hard copies+soft copy	2 Hard copies+ soft copy	2 Hard copies	1 Hard copy+ soft copy	+ 3 hard copies
2	Drawings / documents for Approval (First Submission)	2 Hard copies+soft copy				+3 hard copies
3	Drawings / Documents for approval (second & subsequent submissions till approval)	2 Hard copies+soft copy				+3 hard copies
4	Approved (car 1 or A) Drawings / documents for distribution	2 Hard copies + 1 set of CD-ROM	8 Hard copies + soft copy	2 Hard copies		+3 hard copies
5	As built Drawings / documents	1 Hard copy + 1 set of CD-ROM	10 Hard copies + 2 sets of CD-ROM	2 Hard Copies		+3 hard copy
6	Type Test certificates/Reports	2 Hard copies + Soft copy	2 Hard copies+ soft copy			+2 hard copies
7	Erection Drawings / documents	1 set of CD ROM	8 Hard copies + 2 sets of CD ROM	3 Hard copies		+3 hard copies
8	FINAL Erection / Installation Manual for distribution	2 Hard copies + 1 set of CD ROM	8 Hard copies + 2 sets of CD-ROM	3 Hard copies		+2 hard copies
9	APPROVED Operation & Maintenance Manual (for distribution)	3 Hard copies + 1 set of CD-ROM	10 Hard copies + 2 set of CD-ROM	3 Hard copies		+2 hard copies
10	Commissioning & performance procedure manual for approval (DRAFT) \$\$\$	2 Hard copies	4 Hard copies			+2 hard copies
11	Comm. & procedure manual for distribution (FINAL) \$\$\$	2 Hard copies + 1 set of CD-ROM	11 Hard copies + 2 set of CD-ROM	2 Hard copies		+2 hard copies
12	Performance & functional Guarantee Procedure for approval \$\$\$	2 Hard copies	2 Hard copies			+2 hard copies
13	Performance & functional Guarantee test reports \$\$\$	1 set of CD-ROM	6 Hard copies - 1 set of CD-ROM			+2 hard copies

SPECIFICATION NO. PE-TS-1/2001-166-A000
PROJECT - TABINAGAR TDP

NOTES:

1. The above schedule of submission does not include Docs / Drgs. of quality assurance / inspection and delivery/dispatches.
2. SSS - These Documents shall be submitted to NTPC - Operation Services Dept. for approval directly and an approved copy shall be submitted to NTPC - EC.
3. Any other document not listed above, but is required as per the contract, shall be submitted.
4. Date of submission of softcopy shall be taken as date of submission of document.


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ANNEXURE – 4

GUARANTEED PERFORMANCE DATA


SL. NO.	Description	Parameters
1	Hydrogen generation plant minimum capacity (Nm ³ /hr.)	9
2	Number of streams	2
3	Minimum Capacity of each streams (Nm ³ /hr.)	4.5
4	Hydrogen purity (%) at gas manifolds	99.9
5	Moisture content - gm/m ³ (max)	0.05
6	Minimum capacity of each compressor (Nm ³ /hr.)	5.6
7	Design delivery pressure at its rated duty point Kg/cm ² (g)	150
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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ANNEXURE - 5

GUARANTEED POWER CONSUMPTION

SL. NO.	MAJOR EQUIPMENTS NAME	TOTAL POWER CONSUMPTION TO GENERATE 9 Nm ³ /Hr. (RATED CAPACITY) IN KW
1	Electrolysers cells (2 no's)	
2	Compressors (2 no's working)	
3	Deoxo dryer for 9 Nm ³ /hr.	
	Total power consumption (KW)	


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ANNEXURE - 6
SCHEDULE OF DEVIATIONS

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

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

The BIDDER hereby certifies that the above mentioned are the only deviations from the PURCHASER's Technical Specification for this enquiry. The BIDDER further confirms that in the event any other data and information presented in the BIDDER's proposal and accompanying documents including drawings, catalogues, etc., are at variance with the specific requirements laid out in the PURCHASER's Technical Specifications, then the latter shall govern and will be binding on the BIDDER for the quoted price.

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SECTION – C4

PAINTING REQUIREMENTS

CLAUSE NO.	TECHNICAL REQUIREMENTS
15.02.00	<p>indicator v) Rise/Lower push buttons for stroke position vi) Local LED based annunciation driven by BOP C&I part of DDCMIS (under Employer's scope) vii) Stroke position indicator on the panel.</p> <p>(d.) The normal mode of operation of dosing system shall be through BOP C&I part of DDCMIS (under Employer's scope). Local/Remote selection is to be done from Remote (CR) and indication for the same is to be provided on local panel.</p> <p>(e.) The ON/OFF commands for individual pumps from local push buttons shall act on the respective drives through BOP C&I part of DDCMIS (under Employer's scope).</p> <p>The stroke position and adjustment will be done by 4-20 mA D.C. signal from BOP C&I part of DDCMIS (under Employer's scope) and the pumps stroke actuation should be suitable for accepting 4-20 mA D.C. signal. The pumps are to be provided with 24 V DC, two wire LVDT type position feedback transmitter which will generate 4-20 mA signal indicating stroke position</p>
16.00.00	SPECIFICATION FOR SURFACE PREPARATION & PAINTING
16.01.00	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.
16.02.00	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.
16.03.00	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.
16.04.00	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..
16.05.00	SURFACE PREPARATION
16.05.01	All surfaces to be painted shall be thoroughly cleaned of oil, grease and other foreign matter. Surfaces shall be free of moisture and contamination from chemicals and solvents.
16.05.02	<p>The following surface schemes are envisaged here. Depending upon requirement any one or a combination of these schemes may be used for surface preparation before application of primer.</p> <p>SP1 Solvent cleaning</p> <p>SP2 Application of rust converter (Ruskil or equivalent grade)</p> <p>SP3 Power tool cleaning</p>
<p>NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE</p>	<p>TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2</p> <p style="text-align: right;">A-9-PCP 52C-04</p> <p style="text-align: right;">PAGE 35 40</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	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	Phosphating	
	SP6	Emery sheet cleaning/Manual wire brush cleaning.	
16.06.00	APPLICATION OF PRIMER/PAINT		
16.06.01	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.		
16.06.02	Surfaces prepared as per the surface preparation scheme indicated herein shall be applied with primer paint within 6 hours after preparation of surfaces.		
16.06.03	Where primer coat has been applied in the shop, the primer coat shall be carefully examined, cleaned and spot primed with one coat of the primer before applying intermediate and finish coats. When the primer coat has not been applied in the shop, primer coat shall be applied by brushing, rolling or spraying on the same day as the surface is prepared. Primer coat shall be applied prior to intermediate and finish coats.		
16.06.04	Steel surfaces that will be concealed by building walls shall be primed and finish painted before the floor is erected. Tops of structural steel members that will be covered by grating shall be primed and finish painted before the grating is permanently secured.		
16.06.05	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 to IS-12744.
	PS9	-	Aluminum paint to IS 2339.
	PS9*	-	Heat resistant Aluminum paint to IS-13183 Gr.-I (for temperature above 400 °C) and to IS-13183 Gr.-II (for temperature 200 °C - 400 °C)
	PS13	-	Rust preventive fluid by spray, dip or brush.
	PS14	-	weldable primer-Deoxaluminate or equivalent.
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
	<p>PS16 - High Build Epoxy CDC mastic `15' .</p> <p>PS17 - Aliphatic Acrylic Polyurethane CDE134 ,%V=40.0(min.)</p> <p>PS18 - Epoxy based TiO2 pigmented coat</p> <p>PS19 - Epoxy based Zinc phosphate primer (92% zinc in dry film (min.), %VS=40.0(min.).</p> <p>PS20 - Epoxy based finish paint.</p>				
16.06.06	All weld edge preparation for site welding shall be applied with one coat of weldable primer.				
16.06.07	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.				
<table><tr><td>NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE</td><td>TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2</td><td>AS-PCP SEC 04</td><td>PAGE 37 OF 40</td></tr></table>		NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2	AS-PCP SEC 04	PAGE 37 OF 40
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16.07.00 Primer/Painting Schedule

Sl. No	Description	Surface Preparation	Primer Coat		Intermediate Coat		Finish Coats		Total Min. Painting DFT (Microns)	Colour Shade
			System	Coat	System	Coat	System	Coat		
				Min. DFT / coat (Microns)		Min. DFT / Coat (Microns)		Min. DFT / Coat (Microns)		
1.	All insulated Piping, fittings/ components, Pipe clamps, Vessels/Tanks, Equipments etc.	SP3/SP4	PS 5	2	25	-	PS 4	1	25	75
2.	All un-insulated Piping, fittings/ components, Pipe clamps, Vessels/Tanks, Equipments etc.	SP3/SP4	PS 5	2	25	-	PS 4	3	35	155
		SP3/SP4	PS 9	1	20		PS 9	1	20	40
		SP3/SP4	PS9*	1	20	-	PS9*	1	20	40
3	Constant Load Hanger (CLH), Variable Load Hanger (VLH) and other supports	SP4*	PS19	1	40	-	PS17	1	30	70
4.	Valves									
	Cast	Design temperature <95 °C	SP1/SP2/SP3	1	40	Polyamide Epoxy	PS 17	1	40	180
		Design temperature 95 °C-200 °C	SP1/SP2/SP3	1	20	-	PS9	1	20	40

As per NTPC Colour shade/ coding scheme


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As per

See 14

	Design temperature > 200 °C	SP1/SP2/SP3	PS9*	1	20				PS9*	1	20	40	
Forged	Design temperature <95 °C	SP1 & SP5	PS13/Phenolic fortified alkyd	1	40		Polyamide Epoxy	1	PS17	1	40	180	
	Design temperature 95 °C-200 °C	SP1 & SP5	PS9	1	20		-	-	PS9	1	20	40	
	Design temperature > 200 °C	SP1 & SP5	PS9*	1	20				PS9*	1	20	40	
5.	All Structural Steel components	Outside building and in SG envelope	SP4*	Inorganic Ethyl Zinc Silicate	1	75	PS18	1	a)Epoxy coat b)Final coat of paint PS17	2 1	35 30	250	
		Within building	SP4*	-do-	1	35	PS18	1	a)Epoxy coat b)Final coat of paint PS17	2 1	25 30	150	
6.	Weld Edges	SP6 (Hand cleaning by wire burshing)	PS13 (Weldable primer)	1	25		-	-	-	-	-	-	
§ The first 2 finished coats (total min.DFT of 70 microns) shall be done at shop and the 3 rd finish coat (min.DFT 35 Microns) shall be applied at site.													

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MANDATORY SPARES

CLAUSE NO.	LIST OF MANDATORY SPARES
5.02.00	<div> <div> ii) Shafts iii) Shaft Sleeve iv) Casing Wear ring v) Impeller Bearings vi) Motor Bearings vii) Thrust Bearings viii) Radial Bearings ix) Gland Packing ix) Mechanical seal </div> <div> 1 No. of each type and size 1 Set of each type and size 1 Set of each type and size 1 Set of each type and size 1 Set of each type and size 1 Set of each type and size 1 Set of each type and size 2 Sets of each type and size 4 set of each type and size </div> </div> <div> PLATE TYPE HEAT EXCHANGERS i) Gaskets ii) Plates </div> <div> 10% of total requirement for each type and size 2% of total requirement for each type and size </div>
6.00.00	SPARES FOR HYDROGEN GENERATION PLANT <div> <div>1) Water Electrolyser</div> <div>1 complete cell : 1 Set</div> </div> <div> <div>2) All electronic Cards and power supply card for rectifiers</div> <div>: 1 no of each type</div> </div> <div> <div>3) Spares for Compressors</div> <div> <div>b) Suction and discharge Valves (complete) : 1 set for each stage / size / type.</div> <div>c) Seats of suction and Discharge Valves : 1 set for each stage / size / type.</div> </div> </div>
NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE	<div> <div> TECHNICAL SPECIFICATIONS SECTION-VI PART-F BID DOC NO.: CS-0270-110-2 </div> <div> LIST OF MANDATORY SPARES </div> <div> PAGE 10 OF 29 </div> </div>

CLAUSE NO.	LIST OF MANDATORY SPARES		
	d)	Springs of suction and Discharge Valves	1 set for each stage /size/type.
	e)	Gaskets of suction and discharge valve	2 sets for each stage /size/type.
	f)	Bearings of Drive end, non-drive end, intermediate and motor	1 set of each type /rating
	g)	Piston rings (if applicable)	2 sets of each stage/type
	h)	Diaphragm (if applicable)	2 sets of each stage/type
	i)	Complete piston (if applicable)	1 set of each stage/type
	j)	V-Belts / Coupling	1 set of each type
	k)	Relief / Unloader assembly	1 no of each stage/type
	4)	Feed water Valves	1 no of each type/size
	5)	Filter element	2 sets of each type /rating
	6)	Dryer desiccant	2 complete fill
	7)	Blower	
	a)	Diaphragm (if applicable)	2 nos.
	b)	Belts	1 set
	8)	Hydrogen manifold valves	4 nos. of each type/Size
	9)	Adsorption filter elements with gaskets /O rings	2 sets
	10)	Complete set of valves for isolation for filters, dryers, instruments and drain valves	1 no of each type/rating
	11)	Measuring device for dew point meter	1 no
	12)	Special connection cable for dew point meter	30 meters
	13)	Zenner barrier	2 nos. of each type/rating
	14)	Limit switches	5% of each type/rating or 1 no. whichever is more
	15)	All electronic cards and power supplies	10% of main supply or 2 nos. whichever is more
	16)	Annunciation indicating lamps	100% of main supply
	17)	Oxygen analyser panel and Oxygen analyser sensor	1 no. of each type
NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-F BID DOC NO.: CS-0270-110-2		LIST OF MANDATORY SPARES
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CLAUSE NO.	LIST OF MANDATORY SPARES
	<p>18) Pressure switches : 1 no. each type and rating</p> <p>19) Pressure gauges : 1 no. each type and rating</p> <p>20) Temperature gauge : 1 no. each type and rating</p> <p>21) Flow indicators : 1 no. each type and rating</p> <p>22) Differential pressure switches : 1 no. each type and rating</p> <p>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.</p>
6.01.00	MANDATORY SPARES: LP PIPING
	<p>Valves : 5% of the total population or minimum 1 no. of each type, material, size and class, which ever is higher.</p> <p>Note : Complete valve along with actuator and motor and all other accessories which are the part of original supply shall also be supplied.</p>
7.00.00	MANDATORY SPARES: PCP
	<p>1. Spare gaskets for all the gate valve for sizes 45 mm NB to 500 mm NB : 25% of each type, size & class for one unit or minimum 1 no of each type and size.</p> <p>2. Spare sets of gland packings of all the gate valves for all sizes - do-</p> <p>3. Spare gaskets for all the globe valves for sizes 15 mm NB to 500 mm NB - do-</p> <p>4. Spare sets of gland packings for all the Globe valves for all sizes - do-</p> <p>5. Spare gaskets for NRV for all the valves - do-</p> <p>6. Spare set of Gaskets for safety relief valves, for all sizes - do-</p> <p>7. Complete gate valves assembly up to the size of 50 NB - do-</p>
NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE	<div> <div>TECHNICAL SPECIFICATIONS SECTION-VI PART-F BID DOC NO.: CS-0270-110-2</div> <div>LIST OF MANDATORY SPARES</div> <div>PAGE 12 OF 29</div> </div>

CLAUSE NO.	LIST OF MANDATORY SPARES		
12.02.00 7.00.00	PLC / MICROPROCESSOR BASED CONTROL SYSTEM (To be provided for each plant with PLC based control system)		
	1	Power Supply Unit	20 % or 2 nos. of each type and model, whichever is more.
	2	Electronic modules like I/O, CPU communication, Interface	10 % of each type and model
	3	Cooling fan in PLC system / cabinet	10 % or 2 nos., whichever is more.
	4	Audible devices	1 no.
	5	Graphical interface units	1 no. of each type
	6	Prefab cables and system bus cables	1 no. of each type and length
	7	Relays	10% of 10 nos. of each type and model, whichever is more
	8	Batteries used for battery back up of RAMs	1 set
	9	Fuses	200% of each type and rating


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SECTION – C6

PG TEST PROCEDURE

CLAUSE NO.	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES		
	<p style="text-align: center;">FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES</p> <p style="text-align: center;">FOR</p> <p style="text-align: center;">SHORTFALL IN PERFORMANCE AND GUARANTEE TESTS</p> <p>(The term "Performance Guarantees" wherever appears in this Sub-Section shall have the same meaning and shall be synonymous to "Functional Guarantees". Similarly the term "Performance Tests" wherever appears in this Sub-Section shall have the same meaning and shall be synonymous to "Guarantee Test(s)". The term "TMCR" (Turbine maximum continuous rating) appearing in the Technical Specification shall mean 250 MW electrical power output at generator terminals (power at generator terminals as per clause indicated in this sub-section) under 0% cycle make-up and 77 mm Hg (abs) condenser pressure unless used in conjunction with a different cycle make-up and/or a different condenser pressure.</p>		
1.00.00	PERFORMANCE GUARANTEES		
1.00.01	General Requirements		
	<p>(a) The Contractor shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in these specifications.</p> <p>(b) The guaranteed performance parameters furnished by the Bidder in his offer, shall be without any tolerance values and all margins required for instrument inaccuracies and other uncertainties shall be deemed to have been included in the guaranteed figures.</p> <p>(c) The Contractor shall demonstrate all the guarantees covered herein during functional guarantee / acceptance test. The various tests which are to be carried out during performance guarantee/acceptance test are listed in this Sub-section. The guarantee tests shall be conducted by the Contractor at site in presence of Employer on each unit individually.</p> <p>(d) All costs associated with the tests shall be included in the bid price.</p> <p>(e) In case during performance guarantee test(s) it is found that the equipment/system has failed to meet the guarantees, the Contractor shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements at no extra cost to the Employer and re-conduct the performance guarantee test(s) with Employer's consent. However if the specified performance guarantee(s) are still not met but are achieved within the Acceptable Shortfall Limit specified at clause 1.01.02 of this sub-section, Employer will accept the equipment/system/plant after levying liquidated damages as per clause 1.01.02 of this sub-section. If, however, the demonstrated guarantee(s) continue to be more than the stipulated Acceptable Shortfall Limit, even after the above modifications/replacements within ninety (90) days or a</p>		
NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-A BID DOC. NO.: CS-0270-110-2	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES PAGE 4 OF 22

CLAUSE NO.	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES
	<p>reasonable period allowed by the Employer, after the tests have been completed, the Employer will have the right to either of the following:</p> <p>(i) For Category-I Guarantees</p> <p>Reject the equipment / system / plant and recover from the Contractor the payments already made</p> <p>OR</p> <p>Accept the equipment /system/ plant after levying Liquidated Damages as specified hereunder. The liquidated damages for shortfall in performance indicated in clause 1.01.02 of this sub-section shall be levied separately for each unit. The rates indicated in clause 1.01.02 of this sub-section are on per unit basis. The liquidated damages shall be pro-rated for the fractional parts of the deficiencies. The performance guarantees coming under this category shall be called 'Category-I' Guarantees.</p> <p>(ii) For Category-II Guarantees</p> <p>Reject the equipment / system/ plant and recover from the Contractor the payments already made. The performance guarantees under this category shall be called 'Category-II' Guarantees. Conformance to the performance requirements under Category-II is mandatory.</p> <p>(iii) For Category-III Guarantees</p> <p>Reject the equipment /system / plant and recover from the Contractor the payments already made.</p> <p>OR</p> <p>Accept the equipment/system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by the Employer. Such damages shall, however be limited to the cost of replacement of the equipment(s) / system(s), replacement of which shall remove the deficiency so as to achieve the guaranteed performance. These parameters/capacities shall be termed as Category-III Guarantees.</p>
1.01.00	Guarantees under Category-I
1.01.01	<p>The performance guarantees which attract liquidated damages are as follows:</p> <p>(i) Turbine Cycle Heat rate in kcal/kWhr under rated steam conditions at 77 mm Hg (abs) design condenser pressure with zero make up at 250 MW unit load.</p> <p>(ii) Turbine Cycle Heat rate in kcal/kWhr under rated steam conditions at 77 mm Hg (abs) design condenser pressure with zero make up at 200 MW unit load.</p>
NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-A BID DOC. NO.: CS-0270-110-2
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1.01.00 GUARANTEES UNDER CATEGORY – I

1.01.01 AMOUNT OF LIQUIDATED DAMAGES APPLICABLE FOR CATEGORY –1 GUARANTEES:-

If the performance guarantees specified at clause 1.01.01 are not met by contractor even after the modifications and / or replacements mentioned at clause 1.00.01(e) of this sub section but are achieved within the stipulated acceptable shortfall limit as indicated in this clause, employer will accept the equipments /systems/plant after levying liquidated damages as indicated here under, however, if the demonstrated guarantees continue to be more than the stipulated acceptable shortfall limit, the employer may at his discretion accept the equipment / system only after levying liquidated damages against the contractor , at the rates listed herein, and such liquidated damages as shall be deducted from the contract price:

RATE FOR LIQUIDATED DAMAGE FOR POWER CONSUMPTION:-

In case the successful bidder fails to establish/ prove the guaranteed values of power consumption on actual performance testing at the manufacturing works/ site, penalty @ US \$ 3357.00 per KW increase in power consumption shall be levied.

Bidder to note that for penalty 1/3 of power consumption quoted by bidder shall be used.

1.02.00 GUARANTEES UNDER CATEGORY – II

NIL

1.03.00 GUARANTEES UNDER CATEGORY – III

The parameters / capabilities to be demonstrated for various systems/ equipments shall include but not be limited to the following:

1.03.01 Noise: - All the plant, equipment and systems covered under this specification shall perform continuously without exceeding the noise level over the entire range of output and operating frequency specified in annexure – 6, guaranteed performance data , section C3 of technical specification.

Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirement of IEC 651 or BS 5969 or IS 9779. Sound pressure shall be measured all around the equipment at a distance of 1.0 meter horizontally from the nearest surface of any equipment / machine and at a height of 1.5 meter above the floor level in elevation.

A minimum of 6 points around each equipment shall be covered for measurement. Additional measurement points shall be considered based on the applicable standards and size of equipment. The measurement shall be done with slow response on the A – weighting scale. The average of A – weighted sound pressure level measurements expressed in decibels to a reference of 0.0002 micro bar shall not exceed the guaranteed value. Corrections for background noise shall be considered in exceed the guaranteed value. Corrections for background noise shall be considered in line with the applicable standards. All the necessary data for determining these corrections, in line with the applicable standards, shall be collected during the tests.

2.00.00 PERFORMANCE GUARANTEE / ACCEPTANCE TEST:-


2.01.00 GENERAL REQUIREMENTS:-

2.01.01 It is responsibility of the contractor to perform the performance guarantee / acceptance test as specified in this sub section. The performance tests will be performed using only the normal number of employer supplied operating staff. Contractor, vendor or other subcontractor personnel shall only be used for instructional purposes or data collection. At all times during the Performance Tests the emissions and effluents from the Plant shall not exceed the Guaranteed Emission and Effluent Limits.


2.01.02 The Contractor shall make the plant ready for the performance guarantee tests.

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2.01.03	<p>All instruments required for performance testing shall be of the type and accuracy required by the code and prior to the test, the contractor shall get these instruments calibrated in an independent test Institute approved by the Employer. All test instrumentation required for performance tests shall be supplied by the contractor and shall be retained by him upon satisfactory completion of all such tests at site. All costs associated with the supply, calibration, installation and removal of the test instrumentation shall be included in the bid price. All calibration procedures and standards shall be subjected to the approval of the Employer. The protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes.</p> <p>Tools and tackles, thermowells (both screwed and welded) instruments/devices including flow devices, matching flanges, impulse piping & valves etc. and any special equipment, required for the successful completion of the tests, shall be provided by the contractor free of cost.</p>			
2.01.04	<p>The contractor shall submit for Employer's approval the detailed Performance Test procedure containing the following:</p> <ul style="list-style-type: none"> (a) Object of the test. (b) Various guaranteed parameters & tests as per contract. (c) Method of conductance of test and test code. (d) Duration of test, frequency of readings & number of test runs. (e) Method of calculation. (f) Correction curves. (g) Instrument list consisting of range, accuracy, least count, and location of instruments. (h) Scheme showing measurement points. (i) Sample calculation. (j) Acceptance criteria. (k) Any other information required for conducting the test. <p>The Performance / Acceptance test shall be carried out as per the agreed procedure. The PG test procedure including demonstration tests shall be submitted within 90 days of the date of Notification of Award and finalization of the PG test procedure shall be done within 180 days from the date of Notification of Award. After the conductance of Performance test, the contractor shall submit the test evaluation report of Performance test results to Employer promptly but not later than one month from the date of conductance of Performance test. However, preliminary test reports shall be submitted to the Employer after completing each test run.</p>			
2.01.05	Test Interruptions			
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CLAUSE NO.	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES
	<p>In the event of a test interruption resulting from an Event of Force Majeure or Employer-Caused-Delay, Contractor shall be entitled to relief as provided in the contract, provided that (except for certain interruptions of a Availability Test as specified below), the interrupted Performance Test must be started again and test data that were collected during the interrupted test must be ignored.</p> <p>In the event of test interruptions as a result of Force Majeure or Employer-Caused-Delay during an Availability test, where .</p> <p>(a) The total cumulative interrupted time during the test is more than twenty-four (24) hours.</p> <p>(b) The total number of interruptions during the test is more than four (4).</p> <p>The test shall not be deemed a successful Performance Test.</p> <p>Except as provided above, the interrupted test resulting from Force Majeure or Employer-Caused-Delay shall be extended by an amount of time equal to the length of the interruptions, including time to return to steady-state operation; the test data for the period of interruptions shall be excluded from analysis; and the test data that were collected both before and after the interruptions shall be included in the analysis.</p>
2.01.06	<p>Grid Restriction</p><p>Any loss in generation in terms of power (KW) or energy (KWH) during Availability Test due to grid restrictions shall be treated as deemed generation. However, the total cumulative deemed generation shall not exceed 5% of the total generation during the test period failing which the test shall be extended to limit the deemed generation to 5% of the total generation.</p>
2.02.00	<p>Turbine Generator Performance/ Acceptance Test</p>
2.02.01	<p>Performance test for the turbine generator set will be conducted in accordance with the latest edition of ASME PTC-6. Such test shall be binding on the parties to the contract to determine compliance with the guaranteed heat balance conditions at 250 MW and 200 MW unit outputs corresponding to the conditions stipulated under Cl-1.21.01 of Sub-section - A-3 (Turbine Generator and Auxiliaries), Part - B. Power consumed by the auxiliaries mentioned under clause 1.01.03 of this Sub - section which is to be deducted from electrical power generated, shall be measured during the performance / Acceptance Test. Wherever the measurement is not possible, design values of power consumption by an auxiliary shall be considered.</p>
2.02.02	<p>The essential mandatory requirements for instruments, methods and precautions to be employed shall be in accordance with the requirements specified in the respective codes. All the necessary instruments (in duplicate) required for the tests shall be furnished by the contractor so as to meet the accuracies specified in the codes. Any advanced class instrument system such as those using electronic devices or mass flow technique shall be arranged by the contractor, if required. For determination of primary flow to the turbine, a calibrated low Beta-ratio throat-tap nozzle assembly including required machined straight lengths meeting the</p>
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SECTION – C7
INFORMATION TO BE FURNISHED BY THE BIDDER
ALONG WITH BID

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

1. Bidder to specify the deviations from the specification. If any, in the schedule of deviations enclosed as annexure – 6, section C3 of technical specification. In the absence of duly filled in schedule, it will be presumed that the offer confirms to the specifications in all respects.
2. Electrical load data duly filled in. The format for electrical load is enclosed as annexure – 7, section C3 of technical specification.
3. Guaranteed power consumption duly filled in. The format for guaranteed power consumption is enclosed as annexure – 5, section C3 of technical specification.
4. Bidder shall clearly bring out in the proposal the redundancy features along with configuration diagram and this shall be subjected to BHEL / Employer's approval during detailed engineering.
5. List of spares for:
 - Commissioning spares
 - Recommended spares
6. Any other details mentioned elsewhere.

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SECTION – C8


INFORMATION TO BE FURNISHED BY THE VENDOR AFTER AWARD OF CONTRACT

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Drawings and data to be furnished after award of contract


- Write up and Datasheets.
- P and I Diagram including pipe sizes and terminal points.
- Equipment layout showing building details, headroom, equipment.
- Foundation Design drawings indicating foundation design, load data, anchor bolt location, pocket details etc.
- Pipe, Valves and Instrument schedule.
- Electrical load data.
- Wiring and schematic drawings for various control panels and other equipments.
- General arrangement drawings and detailed piping layout drawings showing valves, supports, hangers etc.
- Write-up on alarm-annunciation, control, interlock and protection.
- General arrangement drawings for all the equipments showing dimensions and detail of materials.
- Characteristic curves for pumps and motors.
- Operating procedures for start up, normal running, shutdown and abnormal operating conditions.
- Instructions for maintenance, assembly and erection of equipments.
- Instructions for proper balancing, alignment, adjustment, checking, and calibration as may necessary.
- All the data and drawings necessary for civil design and construction.
- Detailed technical literature and operating instructions for instruments.
- Other necessary drawings, data etc.
- Electrical equipment layout, Cable trench layout, cable routing, cable schedules and cable termination details.
- Quality plans and field quality plans.
- Bar chart and schedules for drawing submission, manufacturing, erection and commissioning
- Any other drawing required to make the system complete & as required for erection, commissioning & inspection purpose.
- Operation and maintenance manual.
- As built drawings

Note: all major drawing shall be approved by BHEL / NTPC during detailed engineering.

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SECTION – C9

TECHNICAL SPEIFICATION FOR EMPTY HYDROGEN / NITROGEN CYLINDERS

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EMPTY HYDROGEN / NITROGEN CYLINDER (46.7 liters water capacity)

1.0 SCOPE

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

2.0 STANDARD APPLICABLE

Latest edition of IS:3224 and IS:7285

3.0 DIMENSIONS

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

4.0 DESIGN

The top end should be necked down to 2" 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 be conform to IS:7285 and shall be made of seam less solid drawn high carbon manganese steel. The valve body shall be made of brass and internals of stainless steel.


9.0 REQUIREMENT OF CYLINDERS

As per IS:7285

10.0 PAINTING & MARKING ON CYLINDERS

To be as per IS : 7285

11.0 INFORMATION REQUIRED WITH THE OFFER

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Cylinder drawing indicating the following details:

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

12.0


TEST CERTIFICATES

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

13.0

GENERAL

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


	TITLE: TECHNICAL SPECIFICATION FOR HYDROGEN GENERATION PLANT 4X250 MW, NABINAGAR THERMAL POWER PLANT	SPEC. NO. PE-TS-300-168-A000	
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SECTION – D1


DESIGN REQUIREMENTS MECHANICAL

NOTE: - Some of the design requirement specified in section D1 may not be applicable to the bidder design. These requirements shall be accepted as per manufacturer standard practice.

CLAUSE NO.	TECHNICAL REQUIREMENTS																																					
	<p style="text-align: center;">EQUIPMENT SIZING CRITERIA</p> <p>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.</p> <p>1.02.00 For all L.P. piping system covered under this specification, sizing and system design shall be to the requirements of relevant codes and standard indicated elsewhere. In addition to this, requirements of any statutory code as applicable shall also be taken into consideration.</p> <p>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:</p> <p>(a) Water Application</p> <table><tr><th colspan="2">Water Velocity in m/sec</th><th></th><th></th><th></th></tr><tr><th>Pipe Size</th><th>Below 50 mm</th><th>50-150 mm</th><th>200 mm & above</th><th></th></tr><tr><td>(a) Pump suction</td><td>-----</td><td>1.2-1.5</td><td>1.2-1.8</td><td></td></tr><tr><td>(b) Pump discharge and recirculation</td><td>1.2-1.8</td><td>1.8-2.4</td><td>2.1-2.5</td><td></td></tr><tr><td>(c) Header</td><td>-----</td><td>1.5-2.4</td><td>2.1-2.4</td><td></td></tr></table> <p>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.</p> <p>WILLIAM & HAZEN formula shall be used for calculating the friction loss in piping systems with the following "C" value:</p> <table><tr><td>(i)</td><td>Carbon steel pipe</td><td>100</td></tr><tr><td>(ii)</td><td>C.I Pipe/ Ductile Iron</td><td>100</td></tr><tr><td>(iii)</td><td>Rubberlined steel pipe</td><td>120</td></tr><tr><td>(iv)</td><td>Stainless steel pipe</td><td>100</td></tr></table> <p>For calculating the required pump head for pump selection , atleast 10% margin shall be taken over the pipe friction losses and static head shall be calculated from the minimum water level of the tank/ sump/ reservoir from which the pumps draw water.</p>	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		(i)	Carbon steel pipe	100	(ii)	C.I Pipe/ Ductile Iron	100	(iii)	Rubberlined steel pipe	120	(iv)	Stainless steel pipe	100
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																																			
(i)	Carbon steel pipe	100																																				
(ii)	C.I Pipe/ Ductile Iron	100																																				
(iii)	Rubberlined steel pipe	120																																				
(iv)	Stainless steel pipe	100																																				
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	<p>(b) Compressed Air Application</p> <p>Compressed air 6.0 - m/sec.</p> <p>1.04.00 The pipes shall be sized for the worst (i.e. maximum flow, temp. and pressure values) operating conditions.</p> <p>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.</p> <p>1.06.00 Corrosion allowance of 1.6 mm will be added to the calculated thickness being considered.</p> <p>1.07.00 Bend thinning allowance/manufacturing allowance etc. shall be as per the requirement of the design code provision.</p> <p>1.08.00 All high points in piping system shall be provided with vents alongwith valves. All low points shall be provided with drains alongwith valves. 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.</p> <p>1.09.00 Material of construction for pipes carrying various fluids shall be as specified elsewhere.</p> <p>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.</p> <p>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 despatch to site. Alternatively, the flanges on GI pipes may be screwed-on flanges also.</p> <p>1.12.00 Threaded joints shall be provided with Teflon sealant tapes.</p> <p>1.13.00 Following types of valves shall be used for the system/service indicated.</p> <table><tr><th>SYSTEM</th><th colspan="6">TYPES OF VALVES</th></tr><tr><th></th><th>Butterfly</th><th>Gate</th><th>Globe</th><th>Check</th><th>Ball</th><th>Plug</th></tr><tr><td>Water</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td></td></tr><tr><td>Air / H₂</td><td></td><td>x</td><td>x</td><td>x</td><td>x</td><td></td></tr><tr><td>Drains & vents</td><td></td><td>x</td><td>x</td><td>x</td><td></td><td></td></tr><tr><td>Fuel oil (if any)</td><td></td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td></tr></table>	SYSTEM	TYPES OF VALVES							Butterfly	Gate	Globe	Check	Ball	Plug	Water	x	x	x	x	x		Air / H ₂		x	x	x	x		Drains & vents		x	x	x			Fuel oil (if any)		x	x	x	x	x
SYSTEM	TYPES OF VALVES																																										
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1.14.00	Recirculation pipes alongwith valves, break-down orifices etc. shall be provided for important pumping systems as indicated in respective process and instrumentation diagrams (P&IDs). The recirculation pipe shall be sized for minimum 30% design flow of single pump operation or the recommended flow of the pump manufacturer whichever is higher.
2.00.00	TECHNICAL SPECIFICATION
2.01.00	GENERAL Specific technical requirements of low pressure piping, fittings, supports, valves, specialties and tanks etc. have been covered under this Sub-section. It includes details pertaining to design and material of construction for piping, fittings, valves, equipment, etc. cleaning/surface preparation application of primer and painting on overground 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 localised 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.
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2.02.06	The hot lines shall be supported with flexible connections to permit axial and lateral movements. Flexibility analysis shall be carried out for pipelines which have considerable straight run as indicated above and necessary loops/ expansion joint etc. shall be provided as may be necessary depending on layout.		
2.02.07	Piping and fittings shall be manufactured by an approved manufacturer of repute. They should be truly cylindrical of clear internal diameter, of uniform thickness, smooth and strong, free from dents, cracks and holes and other defects.		
2.02.08	For rubber lined ERW pipes, beads shall be removed.		
2.02.09	Inspection holes shall be provided at suitable locations for pipes 800 Nb and above as required for periodic observations and inspection purposes.		
2.02.10	At all intersection joints, it is Contractor's responsibility to design and provide suitable reinforcements as per the applicable codes and standards.		
2.02.11	For large size pipes/ducts, at high point and bends/change of direction of flow, air release valves shall be provided. 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:		
	1	Raw water, ash water, circulating water, aux. cooling water, clarified water, service water, air pre-heater wash water, clarifier sludge and	IS-2062 Gr. B/ASTM A-36/ASTM A-53 type 'E' Gr.B / IS-3589 Gr. 410 /IS-1239 Heavy. For equipment cooling water system
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	<p>equipment cooling water including both primary & secondary circuit (DMCW pH-corrected & ACW, drain water)</p> <p>PASSIVATED DM WATER LINES FOR CELLS, COMPRESSOR AND OTHER AUXILIARY COOLING</p>	<p>wherever DM water is used or alkaline solution is used for pipes 50NB and below, pipe material shall be stainless steel to ASTM A312 Gr. 304 sch. 40 Seamless.</p> <p>However, the piping systems handling Sea-water shall have a coating of high build solvent free Polyurethane (PU) of adequate thickness (minimum 2mm DFT) on the internal surface of the pipes as per AWWA-C-222. Further, the pipes which cannot be PU-coated internally, shall be of stainless steel construction to ASTM-A-312 Gr. 316 (Sch.40 Seamless for pipes 50mm NB & below and welded construction for pipes above 50mm NB).</p>	
	<p>2 Demineralised water, (condenser make up water, Boiler fill and Deaerator Fill water, equipment cooling water piping from overhead tank to suction header of DMCW pumps and chemical dosing system to primary circuit of equipment</p>	<p>Stainless steel to ASTM A-312, Gr.304 welded for sizes above 50mm NB</p> <p>Stainless steel to ASTM A312, Gr. 304 sch. 40 Seamless for sizes 50mm and below cooling water (DMCW System), ECW overhead tank make-up water</p>	
	<p>3 Drinking water</p>	<p>ASTM A-53 type E Gr. B galvanised/ IS 1239 heavy galvanised/IS 3589 Gr 410 galvanised to IS- 4736 or equivalent.</p>	
	<p>4. Instrument air & plant air, HYDROGEN</p>	<p>ASTM A-53 type E Gr. B galvanised/ IS 1239 heavy galvanised/IS 3589 Gr 410 galvanised to IS- 4736 or equivalent.</p>	
	<p>5. (Condensate) spill water/ Deaerator Drain</p>	<p>ASTM A-106 Gr. B</p>	
	<p>6. Oil piping</p>	<p>API 5L</p>	
2.03.06	<p>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.</p>		
2.03.07	<p>Pipes of above 150mm Nb shall be to AWWA-C200/ANSI B 36.10/ASTM A-53/IS 3589. Pipe to be fabricated by the bidder shall be rolled and butt welded from plates conforming to ASTM A-53 type 'E' Gr. B/IS 2062 Gr.B/ASTM-A-36. However, larger pipes, i.e. 1000mm Nb and above shall be made from plates conforming to ASTM A</p>		
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	<p>36/IS 2062 Gr.B and shall meet the requirements of AWWA-M-11 (for deflection & buckling criteria considering water filled pipe as well as vacuum condition that may prevail during transient/surge conditions, truck-load, rail-load and weight density for compacted soil or any other load as the case may be).</p>		
2.03.08	<p>In demineralised water service, the pipes upto 50 Nb shall be of stainless steel ASTM A 312, Gr. 304 sch. 40 Seamless. The size for these pipe shall be to ANSI B 36.19. These shall be socket welded. The material for pipe from 65mm NB upto and including 400 NB shall be to ASTM A 312, Gr. 304 (welded). In no case the thickness of fittings shall be less than parent pipe thickness.</p> <p>Bidder/Contractor shall note that stainless steel pipe offered as per a particular code shall conform to that code in all respects i.e. Dimension, tolerances, manufacturing methods, material, heat treatment, testing requirements, etc. unless otherwise mentioned elsewhere in the specification.</p>		
2.03.09	<p>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 galvanised 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 (galvanised).</p>		
2.03.10	<p>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.</p>		
2.03.11	<p>Condensate lines shall be to ASTM A 106 Gr. B and dimension to ANSI B 36.10 schedule "standard" as minimum to be maintained</p>		
2.04.00	Piping layout		
2.04.01	<p>Piping shall be grouped together where practicable and routed to present a neat appearance.</p>		
2.04.02	<p>Piping routing shall be such as to provide sufficient clearance for removal and maintenance of equipment, easy access to valves, instruments and other accessories. The piping shall not encroach on the withdrawal space of various equipments.</p>		
2.04.03	<p>Over head piping shall have a normal minimum vertical clearance of 2.5 meters above walkways and working areas and 8M above roadways/railways. When several pipe lines are laid parallel, flanged joints must be staggered. Welded and flanged joints should as far as possible be located at one third span from supports. If the support is situated right under the welded joints this joint must be reinforced with a strap. Flanged and welded joints must be avoided in the middle of the span. Valves should be located in such a manner so as to ensure their convenient operation from the floor or the nearest platform.</p>		
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2.04.04	Pipe lines of NB 50 size and below are regarded as field run piping. It is Bidder's responsibility to plan suitable layouts for these system insitu. Bidder shall prepare drawings indicating the layout of field run pipe work. These drawings shall be approved by Project Manager to the installation of the field run pipe work. Based on these approved layouts the Bidder shall prepare the BOQ of field run-pipes and submit to Employer for approval.
2.04.05	All piping shall be routed so as to avoid interference with other pipes and their hangers and supports, electrical cable trays, ventilation ducting, structural members, equipment etc. Adequate clearance shall be ensured with respect to the above to accommodate insulation and pipe movements, if any.
2.04.06	Piping shall generally be routed above ground but where specifically indicated/approved by the Project Manager the pipes may be arranged in trenches or buried. Pipes at working temperature above the ambient shall however not be buried.
2.04.07	Sufficient up stream and down stream lengths shall be provided for flow measuring devices, control valves and other specialities.
2.04.08	All local instruments shall be located on pipe lines as to render them observable from the nearest available platforms.
2.04.09	Openings provided in the wall for pipelines must be closed with bricks and mortar with 10-12 mm clearance between brick work and pipe after taking care of insulation and thermal movement, if any. The clear space must be filled with felt or asbestos or approved filling compound.
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. In addition to the system requirement all low points in the pipelines shall be provided with suitable draining arrangement and all 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 upto 150mm, not less than 20mm upto 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
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
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
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2.06.01	specifically. All air lines shall be of screwed connection and rubber lined pipes of flanged connections.		
	Screwed		
	(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) Galvanised 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. Galvanised pipes shall not be joined by welding. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing. For galvanized pipe sizes above 150 mm NB, screw & socket jointing as per ASTM-A-865 shall be employed for both pipe-to-pipe and pipe-to-fitting jointing. For pipe to fitting connection since no direct threading can be done on the fittings (supplied as per ASTM-A-234 Gr. WPB and ANSI B-16.9) necessary straight pipe lengths acting as match pieces shall be welded to the fitting at both ends and subsequently the free 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 galvanised, or in case match pipes and fittings are already galvanised 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, alongwith 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 150 NB and above. However, the bidder shall ensure the galvanized pipe joints do not fail during hydrotest.		
	(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 galvanised. Any site welding done on galvanised 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 hydrotesting.			
	(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		
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	<p>zinc-silicate paste after welding cannot be done due to inaccessibility of the inside welded surface and where galvanic protection has been impaired due to welding of pipe-to-pipe joint. Thus the last erection joint shall be flanged joint.</p>
2.06.02	<p>Welded</p> <p>(a) For making up welded joints (butt weld or socket weld) the welding shall be performed by manual shielded metal arc process in accordance with the requirements specified elsewhere in the spec. Any welder employed for carrying butt welding shall be qualified as per ASME section IX for the type of joints he is going to weld. Jointing by butt weld, or socket weld shall depend upon the respective piping material specifications.</p>
2.06.03	<p>Flanged</p> <p>(a) Flanged connections for pipes are to be kept to the minimum and used only for connections to vessel, equipments, flanged valves and other fittings like strainer/traps/orifices etc. for ease of connection and maintenance etc. Rubber lined pipes shall be flange joined only.</p> <p>(b) All flanged valves intended for installation on steel piping system, shall have their flanges drilled to ANSI B 16.5 (or equivalent) and according to the pressure class stated in their respective piping material specification.</p> <p>(c) Drilling on flanges of flanged valves must correspond to the drilling of flanges on the piping system on which the valves are installed.</p>
2.07.00	<p>Bends/elbows/mitre bends/ Tees/ Reducers & other fittings</p>
2.07.01	<p>Unless otherwise specified elbows shall be of long radius type.</p>
2.07.02	<p>For pipe sizes upto 65Nb, long radius forged elbows or seamless pipe bends shall be used. Pipe bends, if used, shall be cold bent to a radius measured to the centre line of pipe of 3 to 5 times the pipe diameter.</p>
2.07.03	<p>For steel pipes 80 Nb and above, seamless long radius forged elbows shall be used. For pipe size 350Nb and above mitre bends may be used for all pipes except rubber lined pipes. The bend radius shall be 1½ times the nominal pipe diameter. 90 deg. bends (mitre) shall be in 4 pieces (3 cuts) and 45 deg. mitre bends shall be in 3 pieces 22½ deg. Fabrication of mitre bends shall be as detailed in BS 2633/BS534.</p>
2.07.04	<p>Mitre bends are not acceptable in case of rubber lined mild steel pipes.</p>
2.07.05	<p>For pipe fittings such as reducers and tees, the material shall be to ASTM-A-234 Gr. WPB up to 300 NB. For pipe reducers and tees 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.</p>
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	<p>However, for pipes up to 150 NB, pipe fittings may be supplied with material and dimension conforming to IS 1239 in case parent pipes also conform to IS 1239.</p> <p>For pipes, above 1200 NB, reducer and tees shall be to dimensional standard of AWWA-C-208.</p>		
2.07.06	<p>Stainless steel fittings shall conform to either ASTM-A-182, Gr. 304 (316 for Sea water application, if any) or ASTM-A-403, Gr. WP 304 (316 for Sea water application, if any) Class-S, for sizes upto and including 50mm NB, i.e., the fitting shall be of seamless construction. However, for stainless steel fittings above 50mm NB, the same shall conform to ASTM-A-403, Gr. WP 304 (316 for Sea water application, if any), Class W i.e. the fittings shall be of welded construction strictly in accordance with ASTM-A-403.</p>		
2.07.07	<p>In no case, the thickness of fittings shall be less than the thickness of parent pipe, irrespective of material of construction.</p>		
2.08.00	<p>Flanges</p>		
2.08.01	<p>Flanges shall be slip on type. Welding of flanges in tension is not permitted.,</p>		
2.08.02	<p>All flanges and-flanged drilling shall be to ANSI B 16.5/BS EN-1092 of relevant pressure/temperature class. Flanges shall be fabricated from steel plates conforming to ASTM A 105/IS 2062 Gr. B. However stainless steel flanges shall be fabricated from SS plates to ASTM-A-240, Gr. 304 (316 for Sea water application, if any) or equivalent.</p>		
2.09.00	<p>Specific technical requirement of laying buried pipe with anti corrosive treatment</p> <p>The pipe in general shall be laid with the top of the pipe minimum 1.0 (one) metre below finished general ground level.</p>		
2.09.01	<p>Trenching</p> <p>(a) The trench shall be cut true to the line and level and shall follow the gradient of the pipeline. The width of the trench shall be sufficient to give free working space on each side of the pipe. Trenches shall conform to IS 5822.</p> <p>(b) Free access shall be provided for the welding of the circumferential joints by increasing the width and depth of the trench at these points. There should be no obstruction to the welder from any side so that good welded joint is obtained.</p> <p>(c) The free working space shall conform to IS:5822. The trench shall be excavated so as to provide minimum cover of 1000mm between the top of the pipe and finished grade.</p> <p>(d) Prior to lowering and laying pipe in any trench, the Bidder shall backfill and compact the bottom of the trench or excavation in accordance with IS:5822 to provide an acceptable bed for placing the pipe.</p>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS
2.09.02	<p>(e) Coating and Wrapping shall be done as under</p> <p>Preparation and cleaning of piping</p> <p>(a) The pipeline shall be thoroughly cleaned of all rust, grease, dirt, weld scales and weld burrs etc. moisture or other foreign matter by power cleaning method such as sand blasting, power tool cleaning, etc.. Grease or heavy oil shall be removed by washing with a volatile solvent such as gasoline. Kerosene will not be permitted for cleaning. This cleaning operation shall be immediately followed by priming with the mechanical priming machine.</p> <p>(b) Certain inaccessible portions of the pipeline(which otherwise not possible to be cleaned by power cleaning methods) may be scrubbed manually with a stiff wire brush and scrapped where necessary with specific permission of the Project Manager.</p> <p>(c) The cleaning and priming operation shall be carried out at site. The entire pipe length shall be cleaned but the ends of the pipes shall be left without coating for a distance of 230mm for joints, which shall be coated manually at site after laying, welding and testing the pipe.</p> <p>(d) On the internal surface for pipes 1000 Nb and above, a coat of primer followed by a hot coal-tar enamel or coal tar epoxy painting (cold) shall be applied as found suitable for systems handling other than Sea-water/corrosive water or fluid. However, for pipes handling Sea-water the internal pipe surface shall be Poly-urethane coated with DFT of 2000 micron (minimum) for pipes of all sizes generally following the guidelines of AWWA-C-222.</p>
2.09.03	<p>Coating and wrapping</p> <p>(a) Burried piping shall be coated and wrapped, as per specification, after completion of welded and/or flanged connections, and after completion and approval of Hydro testing. Materials to be used for coating and wrapping of underground pipelines are :</p> <p>(1) Coating primer (coal tar primer)</p> <p>(2) Coating enamel (coal tar enamel)</p> <p>(3) Wrapping materials.</p> <p>(b) All primer/coating/wrapping materials and methods of application shall conform to IS:10221 except asphalt/bitumen material. Materials (primer/coating/wrapping) as per AWWA-C-203 are also acceptable.</p> <p>(c) Protective coating shall consist of coal tar primer, coal tar enamel coating, glass fibre, tissue inner wrap followed by glass fibre or coal tar impregnated kraft outer wrap or finish coat.</p>
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
CLAUSE NO.	TECHNICAL REQUIREMENTS
	<p>(d) Number of coats and wraps, minimum thickness for each layer of application shall be as per IS-10221. Number of coats and wraps shall be decided based on soil corrosivity/ resistivity as indicated in IS-10221. Soil data-for this purpose shall be made available.</p> <p>(e) Total thickness of completed coating shall not be less than 4.0 mm.</p> <p>(f) Alternatively, the anti-corrosive protection can consist of anti-corrosive protection Coal-tar tapes. Material and application of tapes shall conform to AWWA-C-203. These-tapes shall be applied hot over the cold coal tar primer. The total thickness of the finished protective coating shall be 4.0 mm minimum.</p>
2.09.04	<p>Trench bed preparation and back filling</p> <p>Prior to lowering and laying pipe in any excavated trench, the bottom of the trench may require to be back filled and compacted (or as the case may be) to provide an acceptable bed for placing the pipe. Bed preparation in general shall be as per IS:5822.</p>
2.09.05	<p>Laying of galvanised steel (GI) pipes</p> <p>All the joints shall be screwed with socket or flanged. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing Threaded portion on either side of the socket joint shall be applied with Zinc silicate paste.</p> <p>All the provisions for trenching' bed preparation' laying the pipe application of primer' coating' wrapping with tapes and back filling etc. as indicated for "laying of buried piping" and " anti corrosive protection for buried piping" are applicable for buried galvanised steel (GI) pipes also.</p>
2.10.00	<p>Cleaning and flushing</p>
2.10.01	<p>All piping shall, be cleaned by the Bidder before and after erection to remove grease, dirt, dust, scale and welding slag.</p>
2.10.02	<p>Before erection all pipework, assemblies, sub-assemblies, fittings, and components, etc. shall be thoroughly cleaned internally and externally by blast cleaning or by power driven wire brushes and followed by air-blowing. The brushes shall be of the same or similar material as the metal being cleaned. Cleaning of Galvanised pipes shall be done in such a manner that the coating on MS pipe is not affected.</p>
2.10.03	<p>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.</p>
2.10.04	<p>All compressed air pipework shall be cleaned by blowing compressed air .</p>
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CLAUSE NO.	TECHNICAL REQUIREMENTS						
2.11.00	<p>Surface preparation and painting</p> <p>Pipes shall be cleaned both internally and externally thoroughly by blast-cleaning or power tool cleaning method as indicated above. However the internal surfaces of pipes handling sea water are to be grit blasted in accordance with SSPC-SP10. In case of oil piping, cleaning will have to be done by pickling. No painting is required on galvanized pipe surface or galvanized steel surface. However, necessary colour banding for identification as per colour code shall be done. External surface of piping shall be cleaned and prepared as indicated below.</p>						
2.11.01	<p>Primer painting</p> <p>(a) After the surface is prepared two coats of red oxide (zinc chromate) primer conforming to IS-2074 or equivalent shall be applied for non-coastal environment. However, for coastal/saline environment the primer shall be two (2) coats of epoxy based zinc phosphate primer with DFT of 50 micron. Primer shall be applied by brushing to ensure a continuous film without holidays. Primer coat shall be immediately applied without any time lag after the surface preparation.</p> <p>(b) Any equipment which has been given the shop coat of primer shall be carefully examined after its erection in the field and shall be treated with a touch up coat of primer wherever the shop coat has been abraded, removed or damaged during transit/erection, or defaced during welding.</p>						
2.11.02	<p>Finish painting</p> <p>(a) Paint to be used shall be synthetic enamel paint conforming to IS-2932 or equivalent for non-coastal environment. Finish painting shall be carried out in three coats consisting of one intermediate coat and two finishing coats. Dry film thickness (DFT) of painting inclusive of primer thickness shall be at least 150 micron.</p> <p>(b) For coastal environment or saline atmosphere, the painting to be applied over primed surface shall be as follows:</p> <table><tr><td>Intermediate coat</td><td>=</td><td>Epoxy based TiO2 pigmented paint with minimum DFT of 50 micron.</td></tr><tr><td>Finished coat</td><td>=</td><td>Epoxy based finish paint of DFT as 50 micron minimum.</td></tr></table> <p>(c) The primed surface shall be cleaned of dust/dirt/grease etc. without scratching or in any way damaging the primer coat. The intermediate coat shall be allowed to dry before applying the finish coat or as recommended by paint manufacturer.</p> <p>(d) Paint shall be applied by brushing. It shall be ensured that brush marks are a minimum and the requirements of workmanship is as specified in IS-1477.</p>	Intermediate coat	=	Epoxy based TiO2 pigmented paint with minimum DFT of 50 micron.	Finished coat	=	Epoxy based finish paint of DFT as 50 micron minimum.
Intermediate coat	=	Epoxy based TiO2 pigmented paint with minimum DFT of 50 micron.					
Finished coat	=	Epoxy based finish paint of DFT as 50 micron minimum.					
NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2	 LPP	PAGE 13 OF 30				


CLAUSE NO.	TECHNICAL REQUIREMENTS
2.11.03	<p>(e) Paint used shall be stirred frequently to keep the pigment in suspension. Paint shall be of the ready mix type in original sealed containers as packed by the paint manufacturer. No thinners shall be permitted.</p> <p>(f) No painting shall be done in frost/foggy weather or when the humidity is high to cause-condensation on the surface to be painted.</p> <p>(g) The dry film thickness (DFT) after the painting shall not be less than 150 microns, in either case (i.e. coastal environment or Non-coastal environment).</p> <p>Other requirements</p> <p>(a) Paint manufacturers instructions shall be followed in method of application, handling, drying time etc.</p> <p>(b) The colour of the finish paint shall be as per approved colour coding.</p> <p>(c) If finish paint was applied in shop, one coat of finish paint shall be applied at site.</p> <p>(d) The dry film thickness of paint shall not be less than 0.15 mm.</p>
2.11.04	<p>Colour code for identification</p> <p>The pipes shall be colour painted/banded for identification as per the approved colour coding scheme and shall be generally as per IS-9404.</p>
2.12.00	Specification for hangers and supports
2.12.01	All supports and parts shall conform to the requirement of power piping code ANSI B 31.1 or approved equivalent.
2.12.02	While designing supports for rubber lined pipes special consideration should be given. Any kind of welding on these pipes is not allowed after rubber lining.
2.12.03	Hanger for piping 65mm Nb and larger and all spring support assemblies regardless of size shall be completely engineered in conformance with the provisions of power piping code ANSI B 31.1.
2.12.04	Hangers, saddles, supports etc. shall be fabricated from plates/pipes sections conforming to ASTM A 53/IS:2062/IS:226/or equivalent. They shall be designed to provide the required supporting effects and allow pipe line movements as necessary. The structural steel work shall be as per IS:800/BS:4360. Insulation protection saddles shall be used at support point of all insulated piping.
2.12.05	The support shall be so interspaced as to minimise sagging of the pipes and to keep them within permissible limits where pipes are full with the conveying media.
2.12.06	The maximum spans of the supports of straight length shall not exceed the recommended values indicated in ANSI B 31.1.
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.12.07	All pipe supports shall be designed to provide an absolute minimum head room of 2.5 m from floor in passages/walkways.		
2.12.08	At all sliding surfaces of supports suitable arrangement is to be provided to minimise sliding friction.		
2.12.09	In case of non-coastal environment, all components of hangers/supports shall be provided with two coats of primer (red oxide paint) at shop before dispatch to site. After erection they shall be given finish coat of Long Oil Synthetic enamel to IS:2932 of total DFT 100 to 140 microns. CLH & VLH will be primed with Epoxy Zinc rich primer of 50 micron followed by finish painting of Aliphatic Acrylic Polyurethane or equivalent of DFT 65 microns. However, for coastal / saline environment all hangers and supports shall be given a primer coat of chlorinated rubber based zinc phosphate primer of DFT 50 micron, followed by 2 coats having one intermediate coat and other finish coat of chlorinated rubber based TiO2 pigmented paint of DFT 50 micron each.		
2.13.00	Design/Construction/Material Particulars of Gate/ Globe/Check Valves/ Globe Stop Valve/Butterfly valve		
2.13.01	GENERAL (a) All valves shall be suitable for the service conditions i.e flow, temperature and pressure, at which they are required to operate. (b) The valves as well as all accessories shall be designed for easy disassembly and maintenance. (c) Valves to be installed outside shall be required to have the stem properly protected against atmospheric corrosion. (d) All rising stem valves shall be provided with back seat to permit repacking (of glands) with valves in operation. All valves shall preferably be of outside screw and yoke type. (e) All valves shall be closed by rotating the hand wheel in the clockwise direction when looking at the face of the handwheel. In case where the handwheel is not directly attached to the valve spindle suitable gearing shall be introduced. (f) All valves shall have indicators or direction clearly marked on the hand-wheel so that the valves opening/closing can be readily determined. (g) Special attention shall be given to operating mechanism for large size valves with a view to obtaining quick and easy operation ensuring that a minimum of maintenance is required. For valves of size 350mm and above either bevel or spur gearing shall be provided to facilitate manual operation. (h) The valves coming in vacuum lines shall be of extended gland type and/or water sealed.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<div><div><div>(i)</div><div>The actuator-operated valves shall be designed on the basis of the following:</div><div><div>(1)</div><div>The internal parts shall be suitable to support the pressure caused by the actuators;</div></div><div><div>(2)</div><div>The valve-actuator unit shall be suitably stiff so as not to cause vibrations, misalignments, etc.</div></div><div><div>(3)</div><div>All actuator operated valves shall be provided with hand operated gearing mechanism also.</div></div><div><div>(4)</div><div>All actuators operated valves shall open/ close fully within time required by the process but not later than 60 seconds after actuators starts.</div></div></div><div><div>(j)</div><div>Valves coming under the purview of IBR shall meet IBR requirements.</div></div><div><div>(k)</div><div>Gate/sluice valves shall be used for isolation of flow. Gate valves shall be provided with the following accessories in addition to other standard items :</div><div><div>(1)</div><div>Hand wheel</div></div><div><div>(2)</div><div>Position indicator (for above 50 mm NB valve size)</div></div><div><div>(3)</div><div>Bypass valves and gear operators for valves of size 350 NB & above.</div></div><div><div>(4)</div><div>Draining arrangement wherever required.</div></div></div><div><div>(l)</div><div>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.</div></div><div><div>(m)</div><div>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-occurence, 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</div></div><div><div>(n)</div><div>All gate and globe valves shall be provided with back seating arrangement to enable on line changing of gland packing.</div></div><div><div>(o)</div><div>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.</div></div></div>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS
2.13.02	<p>(p) All valves shall be provided with embossed name plate giving details such as tag number, type, size etc.</p> <p>(q) Wherever required valves shall be provided with chain operator, extension spindles and floor stands or any other arrangement approved by Employer so that they can be operated with ease from the nearest operating floor. Wherever necessary for safety purpose locking device shall be provided. Further, necessary small platforms for facilitating easy valve operation shall be provided by the contractor wherever necessary in consultation with project manager within the bid price at no extra cost to employer.</p> <p>(r) All valves except those with rising stems, shall be provided with continuous mechanical position indicators; rising stem valves shall have only visual indication through plastic/metallic stem cover for sizes above 50 mm nominal bore.</p> <p>(s) For CI gate, globe and check valves wherever thickness of body/bonnet is not mentioned in the valves standards, thickness mentioned in IS- 1538 for fitting shall be applicable.</p> <p>VALVE BODY MATERIAL</p> <p>Valve body material for various services shall be as follows:</p> <p>Valve body material for non-sea water application like Raw water, Ash watermake-up and handling water, service water, clarified water, DM cooling water (pH corrected) & drinking water shall be cast iron for sizes 65NB and above ; gun-metal for sizes 50 Nb and below.</p> <p>For compressed air application, valve material shall be galvanised cast carbon steel or forged carbon steel per sizes 65 mm NB & above and Gun metal for sizes 50 NB and below.</p> <p>Valve body material for sea-water application (if applicable) like circulating water, sea-water make-up to circulating water, secondary circuit auxiliary cooling water of ECW system, etc. shall be Austenitic Ductile Iron (D2-Ni) for sizes 65 NB and above; stainless steel (SS 316) for sizes 50mm NB and below.</p> <p>DM water : SS body and disc alongwith SS internals.</p> <p>Condensate : Cast Carbon Steel / Forged Carbon Steel.</p>
2.13.03	<p>The design, material, construction, manufacture, inspection, testing and performance of valves shall comply with all currently applicable statutes, regulations and safety codes in the locality where the valves will be installed. The valves shall conform to the latest editions of applicable codes and standards as mentioned elsewhere. Nothing in this specification shall be construed to relieve the Bidder of his responsibility. Valves in general shall conform to the requirements of the following standards.</p>
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.13.04	Standards and Codes			
	AWWA-C-504	Rubber seated butterfly valves.		
	BS-5155/EN-593	Cast iron and carbon steel 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.		
	2.13.05	End Connections		
		The end connections, shall comply with the following :		
		Socket welding (SW) - ANSI B 16.11		
		Butt Welding (BW) - ANSI B 16.25.		
Threaded (SC) - ANSI B 2.1				
Flanged (FL) - ANSI B 16.5& AWWA-C-207(steel flanges), ANSI B 16.1 (Cast Iron flanges)				
All cast iron\ ductile-Ni iron body valves (gate, globe and non-return) shall have flanged end connections, (screwed ends for Ductile D.2NI body valves are not acceptable).				
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.13.06	All steel and stainless steel body valves of sizes 65 mm and above shall have flanged or butt weldings ends. Valves of sizes below 65mm shall have flanged or socket welded ends. Compatibility of welding between valve body material and connecting pipe material is a pre-requisite in case of butt-welded joints.		
2.13.07	All gun metal body valves shall have screwed ends.		
2.13.08	All flanged end valves/specialities. shall be furnished alongwith matching counter flanges, fasteners, gaskets etc. as required to complete the joints.		
2.14.00	Check Valves		
2.14.01	Check valves shall comply with the following characteristics: (a) For bore greater than 2" the valves must be swing check type or dual plate check type suitable for installation in all positions (vertical and horizontal); (b) For bore smaller than or equal to 2" the valves must be of the piston type to be installed, in horizontal position. (c) In the case of swing check valves, the body seat shall be inclined at such an angle from the vertical as will facilitate closing and prevent chatter.		
2.14.02	Drilling on flanges of flanged valves must correspond to the drilling on flanges of the piping system on which the valves are to be installed.		
2.14.03	All flanged valves intended for installation in steel piping systems shall have their flanges drilled to ANSI B 16.5 (or equivalent) and according to the pressure class.		
2.14.04	Counter flanges to be installed on air pipes shall be screwed-on type irrespective of size.		
2.15.00	Globe Valves		
2.15.01	The globe valves shall have the following characteristics: Straight conveyed flow. right angle preferably, the valves shall be of the vertical stem type.		
2.15.02	Globe valves shall preferably have radiused or spherical seating and discs shall be free to revolve on the spindle.		
2.15.03	The pressure shall preferably be under the disc of the valve. However, globe valves, with pressure over the disc shall also be accepted provided (i) no possibility exists that flow from above the disc can remove either the disc from stem or component from disc (ii) manual globe valves can easily be operated by hand. If the fluid load on the top of the disc is higher than 40-60 KN, bypass valve shall be provided which permits the downstream system to be pressurised before the globe valve is opened.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>(i) The actuator-operated valves shall be designed on the basis of the following:</p> <ol style="list-style-type: none"> (1) The internal parts shall be suitable to support the pressure caused by the actuators; (2) The valve-actuator unit shall be suitably stiff so as not to cause vibrations, misalignments, etc. (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 but not later than 60 seconds after actuators starts. <p>(j) Valves coming under the purview of IBR shall meet IBR requirements.</p> <p>(k) Gate/sluice valves shall be used for isolation of flow. Gate valves shall be provided with the following accessories in addition to other standard items :</p> <ol style="list-style-type: none"> (1) Hand wheel (2) Position indicator (for above 50 mm NB valve size) (3) Bypass valves and gear operators for valves of size 350 NB & above. (4) Draining arrangement wherever required. <p>(l) Globe valves shall be used for regulation purposes. They shall be provided with hand wheel, position indicator, draining arrangement (wherever required) and arrow indicating flow direction.</p> <p>(m) Check valves shall be used for non-return service. They shall be swing, check type or double door (Dual plate) check type with a permanent arrow inscription on the valve body indicating the fluid flow direction. In long distance pipes lines with possibility of surge-occurrence, dual plate check valves are preferable for its spring controlled opening /closing of flaps/doors against flow reversals. However, dual plate check valves shall not be used for sizes more than 600mm NB</p> <p>(n) All gate and globe valves shall be provided with back seating arrangement to enable on line changing of gland packing.</p> <p>(o) All gate and globe valves shall be rising stem type and shall have limit switches for full OPEN and full CLOSED indication wherever required. This will include motor-operated valves also wherever required. In such cases the limit switches shall form an integral part of the valve. Stop-gap arrangement in this respect is not acceptable.</p>		
<p>NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE</p>	<p>TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2</p>	<p>67 LPP</p>	<p>PAGE 16 OF 30</p>




CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.13.02	(p)	All valves shall be provided with embossed name plate giving details such as tag number, type, size etc.		
	(q)	Wherever required valves shall be provided with chain operator, extension spindles and floor stands or any other arrangement approved by Employer so that they can be operated with ease from the nearest operating floor. Wherever necessary for safety purpose locking device shall be provided. 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.		
	(r)	All valves except those with rising stems, shall be provided with continuous mechanical position indicators; rising stem valves shall have only visual indication through plastic/metallic stem cover for sizes above 50 mm nominal bore.		
	(s)	For CI gate, globe and check valves wherever thickness of body/bonnet is not mentioned in the valves standards, thickness mentioned in IS- 1538 for fitting shall be applicable.		
2.13.03	VALVE BODY MATERIAL			
	Valve body material for various services shall be as follows:			
	Valve body material for non-sea water application like Raw water, Ash watermake-up and handling water, service water, clarified water, DM cooling water (pH corrected) & drinking water shall be cast iron for sizes 65NB and above ; gun-metal for sizes 50 Nb and below.			
	For compressed air application, valve material shall be galvanised cast carbon steel or forged carbon steel per sizes 65 mm NB & above and Gun metal for sizes 50 NB and below.			
	Valve body material for sea-water application (if applicable) like circulating water, sea-water make-up to circulating water, secondary circuit auxiliary cooling water of ECW system, etc. shall be Austenitic Ductile Iron (D2-Ni) for sizes 65 NB and above; stainless steel (SS 316) for sizes 50mm NB and below.			
2.13.03	DM water : SS body and disc alongwith SS internals.			
	Condensate : Cast Carbon Steel / Forged Carbon Steel.			
	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		
2.15.04	Globe valves with Nb smaller than or equal to 2" shall be of the integral type. Valves of this type shall be so as to permit the easiest disassembly of the internals (stem and disc).		
2.15.05	For the regulating valves, valves with regulating plug & parabolic outline disc type is preferred.		
2.15.06	All motorised globe valves with regulating plug for which indication of percentage (%) opening are required in the control room shall be provided with necessary position transmitter.		
2.16.00	Gate valves 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 and rising stem type.		
2.17.00	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 for water other than Sea-water. However, for sea-water the air release valves shall be of body material ASTM-A-439 (D2-Ni) and spindle shall be of SS-316. (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.		
2.18.00	Butterfly valves		
2.18.01	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 B) butterfly valves instead of cast Iron body valves are also acceptable for size above 300 mm NB diameter for water application other than Sea-water / corrosive water. In such a case, however, the bidder will		
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	<p>have to necessarily submit thickness calculations, in order to establish the integrity of the fabricated valve body under the system operating pressure condition. Bidder has to clearly indicate the material offered in the bid. No change shall be entertained during detailed engg.</p> <ol style="list-style-type: none"> (1) The valves shall be suitable for installation in any position (horizontal/vertical etc.) and shall be of double-flanged construction. However for sizes 150 NB and below the valves may be lugged Wafer construction. (2) The seals, both on the body (sleeve) and on the disc shall be of the material specified. Necessary shaft seal shall be provided and adequately designed to ensure no leakage across the seal. This seal shall be designed so that they will allow replacement without removal of the valve shaft. The sealing ring on the disk shall be continuous type and easily replaceable. (3) For all types of valves, the design with shaft eccentric to the disc is preferred. The shaft shall be solid type and shall pivot on bushings. Bushings/sleeve type bearings shall be contained in the hub of valve body. The bearing shall be self-lubricated type with low coefficient of friction and should not have any harmful effect on water and on valve components. (4) The design of the shaft shall be such that it will safely sustain maximum differential pressure across the closed valve. The shaft and any key (taper pin etc.) for transmitting the torque between shaft and disc shall be capable of withstanding the maximum torque required to operate the valve. However, the shaft diameter shall not be less than the minimum shaft diameter specified in relevant code. Necessary Torque Calculation and the torque class selected on the basis of the same shall be furnished to the Employer for information. (5) The disc shall rotate from the full open to the tight shut position. The disc shall be contoured to ensure the least possible resistance to flow and shall be suitable for throttling operation. While the disc is in the throttled position, valve shall not create any noise or vibration. (6) The operating mechanism shall be mounted directly on or supported from the valve body. (7) All valves shall be complete with: <ul style="list-style-type: none"> position indicator (located in a visible place) arrow indicating the flow direction; adjustable mechanical stop limiting devices to prevent over travel of valve disc in open/close position. <p>all valves shall be "tight shut off"</p>
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2.18.02	<p>(8) Hand operated valves shall have the following</p> <p>Local hand controls</p> <p>The hand controls shall close the valve with clockwise rotation.</p> <p>The hand controls shall be dimensioned to guarantee an easy maneuver under most severe conditions.</p> <p>The hand controls shall be provided with locking systems suitable to avoid the disc assuming a non-desirable position during the operation.</p> <p>Handwheel shall be made of malleable iron with arms and rims of adequate strength. The handwheel of diameters 300mm or less shall be provided with handles for ease of operation. The pulling force required on the hand wheel rim shall not exceed 25 Kgf when operating the valve under full flow and operating pressure.</p> <p>Valves-350Nb and above shall have pressure equalizing bypass valves, wherever system parameters warrant the same.</p> <p>Valves-350Nb and above shall also be provided with gear operator arrangement suitable for manual operation. Manual operation of valve shall be through worm and gear arrangement having totally enclosed gearing with handwheel diameter and gear ratio designed to meet the required operating torque. It shall be designed to hold the valve disc in intermediate position between full open and full closed position without creeping or fluttering. Adjustable stops shall be provided to prevent over travel in either direction.</p> <p>Limit and torque switches (if applicable) shall be enclosed in water tight enclosures alongwith suitable space heaters for motor actuated valves, which may be either for On-Off operation or inching operation with position transmitter.</p>			
	<p>Material of Construction (Butterfly Valves)</p> <p>Materials and other design details shall be as indicated below :</p> <p>(a) Cast Iron Butterfly Valves</p> <table><tr><td>Body & Disc</td><td>ASTM A48, Gr. 40 with 2% Ni/ IS:210. Gr. FG-260, with 2% Ni and epoxy coated</td></tr><tr><td>Shaft</td><td>BS 970 431 S:291 / EN 57, or AISI-410 or AWWA-permitted shaft material equivalent to EN-57/AISI-410 or better.</td></tr></table>	Body & Disc	ASTM A48, Gr. 40 with 2% Ni/ IS:210. Gr. FG-260, with 2% Ni and epoxy coated	Shaft
Body & Disc	ASTM A48, Gr. 40 with 2% Ni/ IS:210. Gr. FG-260, with 2% Ni and epoxy coated			
Shaft	BS 970 431 S:291 / EN 57, or AISI-410 or AWWA-permitted shaft material equivalent to EN-57/AISI-410 or better.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
2.18.03	Seat ring 18-8 Stainless steel				
	Seal Nitrile Rubber				
	(b) Stainless Steel Butterfly Valves				
	Body & Disc ASTM A 351, Gr. CF8M				
	Shaft ASTM A 182, Gr. 316				
	Disc & Seat Rings EPT/BUNA-N/Neoprene				
	(c) Carbon steel Butterfly Valves				
	Body & Disc ASTM A 216, Gr. WCB				
	Shaft ASTM A 182, Gr. 304				
	Disc & Seat Rings EPT/BUNA-N/Neoprene				
	(d) Austentic Ductile Iron (cast) Butterfly valves				
	Body & Disc ASTM A 439 D2 and epoxy coated internals				
	Shaft SS - 316				
	Seat Rings 18-8 Stainless steel				
	Seal EPT/BUNA/NEOPRENE / EPDM				
2.18.03	Proof of Design Test (Type Test) for Butterfly Valves				
	<p>Proof of Design (P.O.D.) test certificates shall be furnished by the bidder for all applicable size-ranges and classes of Butterfly valves supplied by him, in the absence of which actual P.O.D. test shall be conducted by the bidder in the presence of Employer's representative.</p> <p>All valves that are designed and manufactured as per AWWA-C-504 shall be governed by the relevant clauses of P.O.D test in AWWA-C-504. For Butterfly valves designed and manufactured to EN-593 or equivalent, the P.O.D. test methods and procedures shall generally follow the guidelines of AWWA-C-504 in all respect except that Body & seat hydro test and disc-strength test shall be conducted at the pressures specified in EN-593 or the applicable code. Actuators shall also meet requirements of P.O.D. test of AWWA-C-504.</p>				
2.19.00	MATERIAL OF CONSTRUCTION (GATE/GLOBE/CHECK VALVE)				
	<p>(a) The materials shall generally comply with the following :</p> <p>(1) Cast Steel Valves</p>				
<table><tr><td>NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE</td><td>TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2</td><td> LPP</td><td>PAGE 23 OF 30</td></tr></table>		NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2	 LPP	PAGE 23 OF 30
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>Body & bonnet</p> <p>Disc for non-return valves</p> <p>Trim.</p> <p>(2) Stainless steel valves</p> <p>Body & Bonnet</p> <p>Disc</p> <p>Trim.</p> <p>(3) Cast iron valves</p> <p>Body & bonnet</p> <p>Seating surfaces and rings</p> <p>Disc for non-return valves</p> <p>Hinge pin for non-return valves</p> <p>Stem for gate globe valves</p> <p>Back seat</p> <p>(4) Gun Metal valves</p> <p>Body and bonnet</p> <p>Trim.</p> <p>(5) Austentic Ductile Iron (Cast) Valves</p> <p>Body & bonnet</p> <p>Seating surfaces and rings</p> <p>Disc for non-return valves</p> <p>Hinge pin for non-return valves</p>	<p>ASTM A 216 Gr. WCB/ ASTM A 105</p> <p>ASTM A 216 Gr. WCB/ ASTM A 105</p> <p>ASTM A 182 Gr. F6</p> <p>ASTM A 351 Gr. CF 8M/ ASTM A 182 Gr. 304</p> <p>-do-</p> <p>ASTM 182 Gr. F. 316</p> <p>BS 1452 Gr. 14/ IS-210 Gr. FG 260</p> <p>13% chromium steel</p> <p>BS 1452 Gr. 14/IS-210 Gr FG 260</p> <p>AISI 316</p> <p>13% chromium steel</p> <p>13 % chromium steel</p> <p>IS 318 Gr. 2/ Equivalent Standard</p> <p>-do-</p> <p>ASTM-A-439,D-2 (internals epoxy painted)</p> <p>Stainless steel</p> <p>ASTM-A-439 D2 (epoxy painted)</p> <p>AISI 316</p>	
<p>NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE</p>	<p>TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2</p>	<p>04 LPP</p>	<p>PAGE 24 OF 30</p>


CLAUSE NO.	TECHNICAL REQUIREMENTS
2.20.00	<p>Stem Stainless steel</p> <p>Back seat Stainless steel</p> <p>(b) Cast iron body valves shall have stainless steel stem and seat.</p> <p>(c) Material for counterflanges shall be the same as for the pipings.</p> <p>Float operated valves</p> <p>(a) Valve shall automatically control the rate of filling and will shut off when a predetermined level is reached and close to prevent over flow on pre-set maximum water level. Valve shall also open and close in direct proportion to rise or fall of water level.</p> <p>(b) DESIGN AND CONSTRUCTION FEATURES</p> <p>The following design and construction feature of the valve shall be the minimum acceptable.</p> <p>(c) Valves shall be right angled or globe pattern.</p> <p>(d) Valves shall be balance piston type with float ball.</p> <p>(e) Leather liner shall not be provided.</p> <p>(f) The body and cover material shall be cast iron conforming to ASTM-A 126 Grade 'B' or IS:210 Grade 200 or equivalent, and Float shall be of copper with epoxy painting of two (2) coats. In case of sea-water application the body of valve shall be to ASTM-A-439-D2.</p> <p>(g) Valves shall be suitable for flow velocities of 2 to 2.5m/sec.</p> <p>(h) The valves shall have flanged connections.</p>
2.21.00	<p>PAINTING OF VALVES :</p> <p>Two (2) coats of primer followed by three (3) coats of enamel of approved colour code/shade (usually same as that of connected piping) shall be applied to all exposed surfaces except stainless steel surface and Galvanised steel surface at shop as required to prevent corrosion, before dispatch. The use of grease/oil other than light grade mineral oil, for corrosion protection is prohibited. The total DFT of painting shall be 150 micron (minimum). If during transport, unloading/unpacking or erection at site any part of the painted surface gets damaged, the same shall be made good by the contractor by repainting with compatible painting primer and enamel to the satisfaction of the project manager.</p>
2.22.00	<p>Tanks and Accessories</p>
2.22.01	<p>The designer and manufacturer of storage tanks shall comply with and obtain approval of all currently applicable statutory regulations and safety codes in the</p>
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CLAUSE NO.	TECHNICAL REQUIREMENTS
2.22.02	<p>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.</p> <p>DESIGN AND CONSTRUCTION</p> <p>(a) Design of all vertical atmospheric storage tanks containing water, acid, alkali and other chemical shall conform to IS:803 & API 650.</p> <p>(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.</p> <p>(c) Design temperature of vessels shall be 10 deg.C higher than the maximum temperature that any part of the vessel is likely to attain during the course of operation.</p> <p>(d) Tank shall be made from mild steel plates to BS 4360/IS-2062 Gr.B (or equivalent).</p> <p>(e) The joint efficiency factors to be adopted for design calculations shall be in accordance with the specified design code.</p> <p>(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.</p> <p>(g) The material for flanges shall be of ASTM A 105/ IS-2062 Gr.B.</p> <p>(h) For cylindrical tanks, the plates shall be cold rolled through plate bending machine by several number of passes to true curvature.</p> <p>(i) Vessel seams shall be so positioned that they do not pass through vessel connections. For cylindrical vessel consisting of more than two sections longitudinal seams shall be offset.</p> <p>(j) Tanks shall be provided with float operated level indicators/level gauges/level transmitters and level switches, as required, with complete assembly. Suitable flanged pads for level switches mounting shall also be provided. The level indicator can be top or side mounted as the case may be.</p> <p>(k) In addition to inlet and outlet nozzles, the tanks shall be provided with vents, overflow, drain nozzles complete for various connections on tanks. Overflow lines from storage tanks is to be routed to the nearest surface drains. For tanks containing DM water, Alkaline water or Power cycle water the vent to atmosphere shall be through carbon-di-oxide absorber vessel suitably mounted on the tank. CO2 absorber vessel shall be provided with the initial fill of chemicals. Similarly for equipment cooling water overhead tank, the overflow & drain from tank shall be combined together and shall be led to nearest drain (at zero level) via. a seal-trough so as not to come directly in contact with atmosphere.</p>
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.22.03	(l)	Tanks shall have suitable stairs/ladders on inside and outside of the tanks, manholes/inspection covers as required and also platform suitably located.	
	(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.	
	(n)	Piercing nozzles/pipes from tank body / dish ends shall be adequately compensated as per relevant code.	
	(o)	Tank fabrication drg. and design calculations shall be approved by the Project Manager.	
	Corrosion protection		
2.22.04	(a)	A corrosion allowance, applicable to surface in contact with corrosive media, when required, 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.	
	(d)	Epoxy-coating shall be provided on the inside of vessel in three coats(minimum) resulting in total thickness of not less than 150 micron in which ever case required, such as equipment cooling water overhead tank, sodium hydroxide tank, condensate storage tank, condensate surge tank, DM Water tank etc.	
	(e)	For tank handling Sea-water, the internal surface of the tank in contact with Sea-water shall be having High build solvent free Poly-urethane coating of 2mm DFT generally following the guidelines of AWWA-C-222.	
	Cleaning & Painting		
	(a)	Inside surface of all tanks shall be protected by anti-corrosive paints as required.	
	(b)	For tanks/vessel requiring epoxy or polyurethane painting, all inside surface shall be blast cleaned using non siliceous abrasive after usual wire brushing.	
	(c)	Outside surfaces of all vessels shall be provided with two coats of primer with three (3) coats of epoxy resin based paint of approved colour for non-coastal environment. For coastal environment however, the outside surfaces of tanks shall be given 2 coats of epoxy based zinc phosphate primer of DFT 50 micron followed by an intermediate coat of Epoxy based TiO2 pigmented paint with DFT of 50 micron and finish coat of epoxy based paint of DFT 50 micron.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.22.05	Technical Particulars of Condensate Overhead Surge Tank.		
	Sl. No.	Description	Technical Particulars
	(i)	Quantity per Unit	One (1)
	(ii)	Useful Capacity of Each Tank	Not less than 150 Cu meter
	(iii)	Size (Dia. x length)	Adequate
	(iv)	Design Standard	ASME Section-VIII Div. I/IS:2825 (Class 3)
	(v)	Material Construction	MS Plates to IS: 2062 Gr. B/ASTM A36.
	(v)	Accessories:	
	(a)	Vent, overflow and drain	Required
	(b)	Sample Connection	Required
	(c)	Level Indicator	Required (Gauge-glass)
	(d)	Level Transmitter	Required
	Notes: Number/capacity/size of tank are minimum for bidder's offer purpose. It is bidder's responsibility to design/size these tanks depending upon system requirement/design during detail engg. and submit the design calculation to Engineer for approval alongwith tank GA drg. Additional Control & Instrumentation facilities specified elsewhere in the technical specification shall also be incorporated by the bidder.		
2.23.00	RUBBER EXPANSION JOINTS		
2.23.01	All parts of expansion joints shall be suitably designed for all stresses that may occur during continuous operation and for any additional stresses that may occur during installation and also during transient condition.		
2.23.02	The expansion joints shall be single bellow rubber expansion joints. The arches of the expansion joints shall be filled with soft rubber.		
2.23.03	The tube (i.e. inner cover) and the cover (outer) shall be made of natural or synthetic rubber of adequate hardness. The shore hardness shall not be less than 60 deg. A for outer and 50 deg. A for inner cover.		
2.23.04	The carcass between the tube and the cover shall be made of high quality cotton duck, preferably, square woven to provide equal strength in both directions of the weave. The fabric plies shall be impregnated with age resistant rubber or synthetic compound and laminated into a unit.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
2.23.05	Reinforcement, consisting of solid metal rings embedded in carcass, shall be provided.				
2.23.06	Expansion joints shall be complete with stretcher bolt assembly. The expansion joints shall be suitable to absorb piping movements and accommodate mismatch between pipe lines.				
2.23.07	The expansion joints shall be of heavy duty construction made of high grade abrasion-resistant natural or synthetic rubber compound. The basic fabric for the 'duck' shall be either a superior quality braided cotton or synthetic fibre having maximum flexibility and non-set characteristic.				
2.23.08	The expansion joints shall be adequately reinforced, with solid steel rings, to meet the service conditions under which they are to operate.				
2.23.09	All expansion joints shall be provided with stainless steel retaining rings 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.				
2.23.10	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.				
2.23.11	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.				
2.23.12	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.				
2.23.13	Each joint shall have a permanently attached brass or stainless steel metal tag indicating the tag numbers and other salient design features.				
2.23.14	Bidder to note that any metallic part which comes in contact with DM /corrosive water shall be of Stainless Steel material.				
2.24.00	STRAINERS				
2.24.01	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				
<table><tr><td>NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE</td><td>TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2</td><td>04: LPP</td><td>PAGE 29 OF 30</td></tr></table>		NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2	04: LPP	PAGE 29 OF 30
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CLAUSE NO.	TECHNICAL REQUIREMENTS												
2.24.02	<p>shall have screwed blow off connection fitted with a removable plug. The material of construction of various parts shall be as follows:</p> <table border="0"> <tr> <td>(a) Body</td><td>IS:318, Gr. 2 upto 50 mm Nb, and IS: 210 Gr. FG 260 above 50 mm Nb. (For DM water/sea-water -Body: AISI 316 or equivalent)</td></tr> <tr> <td>(b) Strainer Element</td><td>Stainless steel (AISI 316)</td></tr> <tr> <td>(c) End connection</td><td>Screwed upto 50 mm Nb, and Flanged above 50 mm Nb</td></tr> </table> <p>Duplex type</p> <p>(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.</p> <p>(b) Wire mesh (if applicable) of the strainers shall be suitably reinforced. The material of construction of various parts shall be as follows.</p> <table border="0"> <tr> <td>Body</td><td>IS:318, Gr. 2 (SS-316 or Duplex S.S for Sea-water) upto 50 mm Nb, and IS:210, Gr. FG 260 or ASTM-A-515 Gr. 75/IS-2062 Gr. B (D2-Ni to ASTM-A-439 for Sea-water) and internally epoxy-painted above 50 mm NB.</td></tr> <tr> <td>Strainer element</td><td>Stainless steel (AISI 316)</td></tr> <tr> <td>End connection</td><td>Screwed upto 50mm Nb, and flanged above 50 mm Nb. Gasket shall be of full face type</td></tr> </table> <p>(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.</p> <p>(d) The size of the strainer and the flow direction will be indicated on the strainer body casting.</p> <p>(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.</p>	(a) Body	IS:318, Gr. 2 upto 50 mm Nb, and IS: 210 Gr. FG 260 above 50 mm Nb. (For DM water/sea-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	Body	IS:318, Gr. 2 (SS-316 or Duplex S.S for Sea-water) upto 50 mm Nb, and IS:210, Gr. FG 260 or ASTM-A-515 Gr. 75/IS-2062 Gr. B (D2-Ni to ASTM-A-439 for Sea-water) and internally epoxy-painted above 50 mm NB.	Strainer element	Stainless steel (AISI 316)	End connection	Screwed upto 50mm Nb, and flanged above 50 mm Nb. Gasket shall be of full face type
(a) Body	IS:318, Gr. 2 upto 50 mm Nb, and IS: 210 Gr. FG 260 above 50 mm Nb. (For DM water/sea-water -Body: AISI 316 or equivalent)												
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Strainer element	Stainless steel (AISI 316)												
End connection	Screwed upto 50mm Nb, and flanged above 50 mm Nb. Gasket shall be of full face type												
2.24.03	<p>Two shop coats of paint preceded by two coats of primer shall be applied to all exposed surfaces as required to prevent corrosion. Such painting shall be suitable for coastal environment, if the equipment is installed in coastal project. All parts shall be adequately protected for rust prevention. The use of grease or oil other than light grade mineral oils for corrosion protection is prohibited.</p>												
NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE	<div>TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2</div> <div> LPP</div> <div>PAGE 30 OF 30</div>												

	TITLE: TECHNICAL SPECIFICATION FOR HYDROGEN GENERATION PLANT 4X250 MW, NABINAGAR THERMAL POWER PLANT	SPEC. NO. PE-TS-300-168-A000	
		VOLUME II-B	
		SECTION	
		REV. NO. 0	DATE:
		SHEET	OF

SECTION – D2

DESIGN REQUIREMENTS ELECTRICAL



**ELECTRICAL EQUIPMENT SPECIFICATION
FOR
HYDROGEN GENERATION PLANT
NABINAGAR TPP (4X250 MW)**

SPECIFICATION NO.
PE-TS-300-168-A001
VOLUME NO. : II-B
SECTION : 02
REV NO. : 0 DATE : 15.04.2008
SHEET : 1 OF 2

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

- 1.0 **SCOPE OF WORK BETWEEN BHEL & BIDDER**
- 1.1 Scope for SUPPLY and E&C of various equipments forming part of electrical system for this package shall be as per Annexure-2 to Section-C [Electrical Scope of Work between BHEL & Vendor].
- 2.0 **TECHNICAL REQUIREMENTS**
- 2.1 All electrical equipment shall be suitable for the power supplies, fault levels and other climatic conditions which shall indicated in Project Information for specific project for which enquiry shall be given by purchaser.
- 2.2 Motors rated up to 200 KW shall be connected to LT Switchgear and motor rated above shall be connected to HT Switchgear.
- 2.3 In case of any conflict in data sheet-A & the standard specification, data sheet-A shall prevail.
- 2.4 Bidder to furnish Electrical Load Data for AC/DC drive motors, 415V AC, 240V AC, 220V AC supply feeders for complete H2 Plant System in the enclosed as per Annexure-7 to Section-C.
- 2.5 Applicable QPs for motor is as enclosed with to motor specification. Bidder shall furnish QPs for ultimate customer's approval during detailed engineering stage. There shall be no commercial implication to purchaser on account of QP approval.
- 2.6 Minimum thickness of gland plate shall be 3.0 mm for magnetic material and 4.0mm for non-magnetic materials.
- 2.7 Double compression Ni-Cr plated brass cable glands and solderless crimping type heavy duty lugs for power cables / heavy duty tinned copper lugs for control cables shall be supplied by vendor as integral part of equipment.
- 2.8 Interposing relays (RE 302 of Jyoti make or equivalent), if required for PLC and microprocessor based system, shall be provided by BHEL in MCCs. Requirement of these relays in the form of BOQ shall be furnished by vendor during detailed engineering stage.
- 2.9 Paint shade: As approved by customer
- 2.10 Make of various equipments/ items in the scope of bidder shall be subject to approval of BHEL/customer during detailed engineering stage without any commercial implications.
- 3.0 **INFORMATION TO BE FURNISHED ALONGWITH THE BID**
- 3.1 Electrical Load Data duly filled up for complete AC System.



**ELECTRICAL EQUIPMENT SPECIFICATION
FOR
HYDROGEN GENERATION PLANT
NABINAGAR TPP (4X250 MW)**

SPECIFICATION NO.
PE-TS-300-168-0001
VOLUME NO. : **II-B**
SECTION : **D2**
REV NO. : **0** DATE : 15.04.2008
SHEET : 2 OF 2

- 3.2 Duly stamped & signed copy Annexure-2 to Section-C [Electrical Scope of Work between BHEL & Vendor] as a token of compliance.
- 3.3 Duly stamped & signed copy of Table-1 enclosed with Section-D2 [General Technical requirements of various electrical items], as a token of compliance to standard specifications.

NOTES:

1. Data sheets-A of above electrical items are also enclosed along with standard specifications.
2. Bidder shall be responsible for the following after award of the contract:
 - Filled up motor data sheet-C
 - Power and control cable list for generating cable schedules.
 - Cable termination details interconnection drawings etc.
 - Electrical equipment layout.
 - Cable block diagram.

**IT IS CONFIRMED THAT OUR TECHNICAL OFFER COMPLIES WITH THE SPECIFICATION
IN TOTO, & THAT THERE ARE NO TECHNICAL DEVIATIONS.**

BIDDER'S STAMP & SIGNATURE

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% shall be considered. The equipment shall operate in a highly polluted environment.		
1.02.00	All equipments 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, equipments, 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	The auxiliary AC voltage supply arrangement shall have 6.6 kV and 415V systems. It shall be designed to limit voltage variations as given below under worst operating condition :		
	(a) 6.6 kV	+/- 6%	
	(b) 415/240V	+/- 10%	
1.06.00	The voltage level for motors shall be as follows :-		
	a) Upto 0.2KW	: Single phase 240V AC / 3 phase 415V AC	
	b) Above 0.2KW and upto 200KW	: 3 phase 415V AC	
	c) Above 200KW	: 6.6 kV	
1.07.00	Fault level shall be limited to 40kA RMS for 1 second for 6.6 kV system and 45 kA RMS 1 second for 415V system. 415V system shall be solidly grounded and 220 VDC system shall be isolated type.		
1.08.00	Paint shade shall be as per RAL 5012 (Blue) for indoor and outdoor equipment.		
1.09.00	The responsibility of coordination with electrical agencies and obtaining all necessary clearances shall be of the contractor.		
1.10.00	Degree of Protection		
	Degree of protection for various enclosures as per IS:13947 shall be as follows :-		
	i) Indoor motors	-	IP 54
NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2	B-2: MOTORS PAGE 1 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	ii)	Outdoor motors	- IP 55
	iii)	CW motors (in case of screen prot. Drip proof)	- IP 23
2.00.00	CODES AND STANDARDS		
	1)	Three phase induction motors	: IS:325, IEC:60034
	2)	Single phase AC motors	: IS:996, IEC:60034
	3)	Crane duty motors	: IS:3177, IEC:60034
	4)	DC motors/generators	: IS:4722
3.00.00	TYPE		
3.01.00	AC Motors:		
	(a)	Squirrel cage induction motor suitable for direct-on-line starting.	
	(b)	Crane duty motors shall be slip ring/ squirrel cage Induction motor as per the requirement.	
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 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.	
5.00.00	TEMPERATURE RISE		
	Air cooled motors		
	70 deg. C by resistance method for both class B&F insulation.		
	Water cooled		
	80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method for both class B&F insulation.		
NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2	B-2: MOTORS
			PAGE 2 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS
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) 85% up to 1500KW (d) 80% from 1501 KW to 4000KW (e) 75% > 4000KW
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). CW motors can be screen protected drip proof (SPDP) type. Motors 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 plant area : Group - IIC (or Group-I, Div-II as per NEC)
NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
7.03.00	<p>Winding and Insulation</p> <p>(a) Type : Non-hygroscopic, oil resistant, flame resistant</p> <p>(b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature. However, conveyor motors shall be suitable for 3 consecutive hot starts followed by one hour interval at standstill with maximum 20 starts per day and minimum 20,000 starts during life time of motor.</p> <p>(c) 6.6 kV AC motors : Class F , with winding temperature rise limited to class B. The winding insulation process shall be total Vacuum Pressure Impregnated i.e resin poor method. They shall withstand 1.2/50 microsec. switching surges of 4U+5 KV (U=Line voltage in KV). The coil inter-turn insulation shall be suitable for 0.3/3 micro sec. surge of 20 KV .</p> <p>(d) 240VAC, 415V AC & 220V DC motors : Class B or better</p> <p>(e) Short circuit rings of conveyor motors shall be either jointless or welded type. Brazed joint is not acceptable.</p>			
7.04.00	Motors rated above 1000KW shall have insulated bearings to prevent flow of shaft currents.			
7.05.00	Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.			
7.06.00	Noise level for all the motors shall be limited to 85dB(A) except for BFP motor for which the maximum limit shall be 90dB(A). Vibration shall be limited within the limits prescribed in IS:12075 . 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 2 numbers duplex platinum resistance type temperature detectors.			
7.08.00	Motor body shall have two earthing points on opposite sides.			
7.09.00	HT motors can be offered with either elastimould termination or dust tight phase separated double walled (metallic as well as insulated barrier) cable boxes. In case elastimould terminations are offered, then protective cover and trifurcating sleeves			
NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2		B-2: MOTORS PAGE 4 OF 8


CLAUSE NO.	TECHNICAL REQUIREMENTS		
	shall also be provided. In case cable box is offered, then Employer shall provide termination kit. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided in case of cable boxes.		
7.10.00	The spacing between gland plate & centre of terminal stud shall be as per Table-I.		
7.11.00	All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.		
7.12.00	The motors shall be suitable for bus transfer schemes provided on the 6.6 kV /415V systems without any injurious effect on its life.		
7.13.00	For motors rated 2000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.		
7.14.00	6.6KV motor Terminal Box shall be suitable for fault level of 500MVA for 0.12 sec.		
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.		
7.16.00	The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance)		
	(a) Upto 110KW:	11.0	
	(b) Above 110KW & upto 1500KW:	10.0	
	(c) Above 1500KW & upto 4000KW:	9.0	
	(d) Above 4000KW:	6 to 6.5	
8.00.00	TYPE TEST		
8.01.00	HT MOTORS		
8.01.01	The contractor shall carry out the type tests as indicated in the "LIST OF TYPE TESTS TO BE CONDUCTED " on the equipment mentioned there in. The Bidder shall indicate the charges for each of these type tests separately in the relevant schedule of BPS and the same shall be considered for the evaluation of the Bids. The type test charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the Owner's Engineer.		
8.01.02	The type tests shall be carried out in presence of the Owner's representative, for which minimum 15 days notice shall be given by the Contractor. The Contractor shall obtain the Owner'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.		
NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2	B-2: MOTORS PAGE 5 OF 8

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CLAUSE NO.	TECHNICAL REQUIREMENTS		
8.01.03	In case the contractor has conducted such specified type test(s) within last five years as on the date of bid opening, he may submit the reports of the type tests indicated in the "LIST OF TYPE TESTS TO BE CONDUCTED " to the owner for waival of conductance of such type test(s).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. The Owner reserves the right to waive conducting of any or all of 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.		
8.01.04	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 five 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. In case the Contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval.		
8.01.05	<p>LIST OF TESTS TO BE CONDUCTED</p> <p>The following type tests shall be conducted on each type and rating of HT motor</p> <p>(a) No load saturation and loss curves upto approximately 115% of rated voltage</p> <p>(b) Measurement of noise at no load.</p> <p>(c) Momentary overload test (subject to test bed constraint).</p> <p>(d) Full load test (subject to test bed constraint).</p> <p>(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.</p> <p>(f) Surge withstand test on the sample coil after placing it in stator core at (4U + 5 KV) and with at least five impulse of 1.2/50 micro sec. Wave, where U is the line to line voltage in kV.</p> <p>(g) Surge-withstand test at 20 KV with 0.3/3 micro sec. wave on each type of 6.6 kV motor coils respectively with at least five such impulses</p>		
NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2	B-2: MOTORS	PAGE 6 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS		
8.01.06	<p>LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED</p> <p>The following type test reports shall be submitted for each type and rating of HT motor</p> <p>(a) Degree of protection test for the enclosure followed by IR, HV and no load run test.</p> <p>(b) Terminal box-fault level withstand test for each type of terminal box of HT motors only.</p>		
8.02.00	LT Motors		
8.02.01	LT motors shall be of type tested quality. For each type & rating of LT motors rated above 50 KW, the contractor shall submit for Owner's approval the reports of all the type tests as per relevant standards and carried out within last five 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.		
8.02.02	In case the Contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval.		
8.03.00	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.		
NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2	B-2: MOTORS	PAGE 7 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS																														
	<p style="text-align: center;">TABLE - I</p> <p style="text-align: center;">DIMENSIONS OF TERMINAL BOXES</p> <p>FOR LV MOTORS:</p> <table><tr><th>Motor MCR in KW</th><th>Minimum distance between centre of stud and gland plate in mm As per manufacturer's practice.</th></tr><tr><td>UP to 3 KW</td><td></td></tr><tr><td>Above 3 KW - upto 7 KW</td><td>85</td></tr><tr><td>Above 7 KW - upto 13 KW</td><td>115</td></tr><tr><td>Above 13 KW - upto 24 KW</td><td>167</td></tr><tr><td>Above 24 KW - upto 37 KW</td><td>196</td></tr><tr><td>Above 37 KW - upto 55 KW</td><td>249</td></tr><tr><td>Above 55 KW - upto 90 KW</td><td>277</td></tr><tr><td>Above 90 KW - upto 125 KW</td><td>331</td></tr><tr><td>Above 125 KW-upto 200 KW</td><td>203</td></tr></table> <p>FOR HT MOTORS:</p> <p>The distance between gland plate and the terminal studs shall not be less than 500 mm.</p> <p>PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:</p> <p>NOTE: Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:</p> <table><tr><th>Motor MCR in KW</th><th>Clearance</th></tr><tr><td>UP to 110 KW</td><td>10mm</td></tr><tr><td>Above 110 KW and upto 150 KW</td><td>12.5mm</td></tr><tr><td>Above 150 KW</td><td>19mm</td></tr></table>			Motor MCR in KW	Minimum distance between centre of stud and gland plate in mm As per manufacturer's practice.	UP to 3 KW		Above 3 KW - upto 7 KW	85	Above 7 KW - upto 13 KW	115	Above 13 KW - upto 24 KW	167	Above 24 KW - upto 37 KW	196	Above 37 KW - upto 55 KW	249	Above 55 KW - upto 90 KW	277	Above 90 KW - upto 125 KW	331	Above 125 KW-upto 200 KW	203	Motor MCR in KW	Clearance	UP to 110 KW	10mm	Above 110 KW and upto 150 KW	12.5mm	Above 150 KW	19mm
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NABINAGAR THERMAL POWER PROJECT (4 X250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2	B-2: MOTORS	PAGE 8 OF 8																												

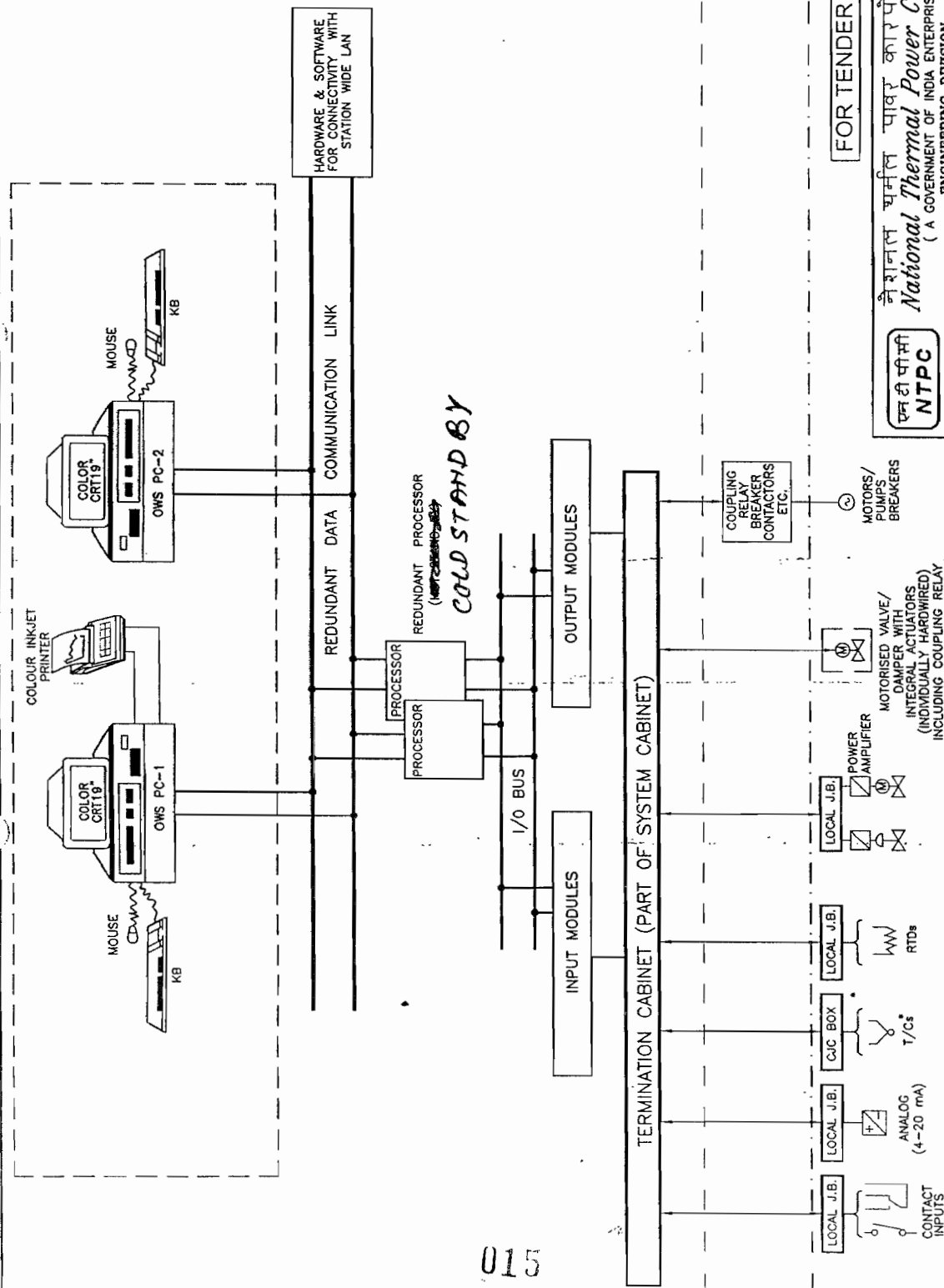
	TITLE: TECHNICAL SPECIFICATION FOR HYDROGEN GENERATION PLANT 4X250 MW, NABINAGAR THERMAL POWER PLANT	SPEC. NO. PE-TS-300-168-A000	
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SECTION – D3

DESIGN REQUIREMENTS CONTROL AND INSTRUMENTATION

015

MCC/
SWITCHGEAR



FOR TENDER PURPOSE ONLY

एन टी पी
NTPC
नेशनल थर्मल पावर कारपोरेशन लिमिटेड
National Thermal Power Corporation Ltd.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

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

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	CONTROL AND INSTRUMENTATION FOR PLANT AUXILIARY SYSTEMS		
1.00.00	CONTROL AND INSTRUMENTATION FOR PLANT AUXILIARY PACKAGES		
1.01.00	Contractor shall provide complete Control and Instrumentation system with all accessories, auxiliaries and associated equipments and cables for the safe, efficient and reliable operation of the plant auxiliary systems as indicated under scope part at IIC, Part-A, Section VI.		
1.02.00	The quantity of instruments for each plant auxiliary system shall be as per tender P&ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all instruments and devices, which are needed for the completeness of the plant auxiliary system/equipment, supplied by the Contractor, even if the same is not specifically appearing in the P&ID. Also refer item MEASURING INSTRUMENTS, Subsection CONTROL & INST, Part A Section VI.		
1.03.00	All instruments and control equipments like primary and secondary instruments etc. shall meet the requirements specified in Sub-section: MEAS INST Part-B, Section VI. In addition, all electrical instrument devices like switches/transmitters/controllers/analysers/solenoid valves which are located in the field/hazardous locations like hydrogen generation plant shall be provided with explosion proof enclosure suitable for hazardous areas described in National Electric Code (USA), Article 500, Class-I, Division-I. All field wiring should be through conduits. All fittings, cable glands etc. shall be strictly as per NEC recommendation article, 500 to 503.		
1.04.00	Contractor shall provide independent control systems for safe, efficient and reliable operation of the plant auxiliary systems. The type of control system shall be as indicated under scope part at IIC, Part-A, Section VI.		
1.05.00	ON/OFF control, indication, annunciation of incomers and bus-coupler are also to be performed from Contractor's Control System for each of the above system as applicable.		
1.06.00	It shall be possible to remove/replace online various modules (like any I/O module, interface module, etc.) from its slot for maintenance purpose without switching off power supply to the corresponding rack. System design shall ensure that while doing so, undefined signaling and releases do not occur and controller operation in any way is not affected (including controller trip to manual, etc) except that information related to removed module is not available to controller. Further, it shall also be possible to remove/replace any of the redundant controller modules 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 jeopardise safety of plant and personnel.		
1.07.00	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). The faults to be reported shall include fault in main & standby power supplies, sensor fault, Input/ Output card failure, Memory Status, Controller fault,		
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	<p>failure of Communication/ Network links to PLCs, LAN etc. These faults shall be reported as colour change on system status display and as messages on HMIS as well as through local indication on the faulty module and on respective rack/ cubicle. The diagnostic system shall ensure that the faults are detected before any significant change in any controller output has taken place.</p>		
1.08.00	<p>The Control system shall operate in non-air conditioned area and shall meet the minimum requirements as specified below. The Contractor shall, however, provide a Package AC for his control system his Control system. The Control system shall meet the minimum requirements as specified below.</p>		
1.09.00	<p>Also refer configuration diagram for PLC based off-site control system, drawing no. 0000-999-POI-A-013.</p>		
2.00.00	PROGRAMMABLE LOGIC BASED CONTROL SYSTEM		
2.01.00	<p>PLC PROCESSOR</p> <p>The processor unit shall be capable of executing the following functions:-</p> <ul style="list-style-type: none">a Receiving binary and analog signals from the field and providing command output to MCC/SWGR/Drive etc. through Input / Output modules and operator initiated commands from HMIS / control panel.b Implementing all logic functions for control, protection and annunciation of the equipment and systems.c Implementing modulating control function for certain application as specified elsewhere in the specification.d Providing supervisory information for alarm, various types of displays, status information, trending, historical storage of data etc.e Performing self-monitoring and diagnostic functions.		
2.02.00	<p>For a Dual processor based PLC system, each PLC unit shall be provided with two processors (Main processing unit and memories) one for normal operation and one as standby. In case of failure of working processor, there shall be an appropriate alarm and simultaneously the standby processor shall take over the complete plant operation. In case of hot standby configuration, this transfer shall be automatic. 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.</p> <p>Wherever multiple functional groups have been specified/ required, the above requirements are applicable for each functional group.</p>		
2.03.00	<p>The memory shall be field expandable. The memory capacity shall be sufficient for the complete system operation and have a capability for at least 20% expansion in</p>		
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	future. Programmed operating sequences and criteria shall be stored in non volatile semi conductor memories like EPROM. All dynamic memories shall be provided with buffer battery back up which shall be for at least 360 hours. The batteries shall be lithium or Ni-Cd type.		
2.04.00	Priority of different commands shall be as follows:		
2.04.01	Manual intervention shall be possible at any stage of operation. Protection commands shall have priority over manual commands and manual commands shall prevail over auto commands.		
2.04.02	A forcing facility shall be provided for changing the states of inputs and outputs, timers and flags to facilitate fault finding and other testing requirements. It shall be possible to display the signal flow during operation of the program.		
2.05.00	HUMAN MACHINE INTERFACE SYSTEM (HMIS) PC based OWS (Operator Work Station) shall perform control, monitoring and operation of all auxiliaries/ drives interacting with PLC based control system. It shall be possible to use the same as programming station of the PLC and the Human Machine Interface System. It shall basically perform the following functions. In case the PC based OWS/GIU can not be used as programming station of the PLC and the Human Machine Interface System, then separate PC based programming station shall be provided. Refer Subsection II C, Part A, and Section VI for exact number of Operator Workstations to be provided for each of the control systems. Specification of PC is provided below.		
2.05.01	All OWS of the HMIS shall be fully interchangeable i.e. all operator functions including control, monitoring and operation of any plant area on drive shall be possible from any of the OWS at any point of time without the necessity of any action like downloading of additional files. Operator shall be able to access all control/information related data under all operating conditions including a single processor/computer failure in the HMIS.		
2.05.02	All frequently called important functions including major displays shall be assigned to dedicated function keys on a soft keyboard for the convenience of the operator for quick access to displays & other operator functions.		
2.05.03	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 finalised during detailed engineering.		
2.05.04	The display selection process shall be optimised 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		
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2.05.05	<p>targets defined on the displays. There should be no limitation on number of such targets.</p> <p>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).</p> <p>When any drive or sequence is being controlled from one OWS, the system shall inhibit control access of the same drive or sequence from other OWS or Local Control Panel.</p>			
2.06.00	<p>PROGRAMMING FUNCTIONALITIES</p> <p>Programming of the PLC Processor / controller as well as programming of HMIS shall be user friendly with graphical user interface and shall not require knowledge of any specialised language. For example, the programming of PLC shall use either of the following:-</p> <p>Flow-chart or block logic representing the instructions graphically.</p> <p>Ladder diagrams.</p> <p>The programming of HMIS (like development and modification of data base, mimics, logs / reports, HSR functionalities etc.) shall also be possible through user-friendly menus etc.</p> <p>All programming functionalities shall be password protected to avoid unauthorised modification.</p>			
2.07.00	<p>SOFTWARE REQUIREMENT</p> <p>All necessary software required for implementation of control logic, operator station displays / logs, storage & retrieval and other functional requirement shall be provided. The programs shall include high level languages as far as possible. The contractor shall provide sufficient documentation and program listing so that it is possible for the Employer to carry out modification at a later date.</p> <p>The Contractor shall provide all software required by the system for meeting the intent and functional/parametric requirements of the specification.</p> <p>Industry standard operating system like UNIX/WINDOWS (latest version) etc. to ensure openness and connectivity with other system in industry standard protocols (TCP-IP/ OPC etc.) shall be provided. The system shall have user friendly programming language & graphic user interface.</p>			
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	<p>All system related software including Real Time Operating System, File management software, screen editor, database management software. On line diagnostics/debug software, peripheral drivers software and latest versions of standard PC-based software and latest WINDOWS based packages etc. and any other standard language offered shall be furnished as a minimum.</p> <p>All application software for PLC system functioning like input scanning, acquisition, conditioning processing, control and communication and software for operator interface of monitors, displays, trends, curves, bar charts etc. Historical storage and retrieval utility, and alarm functions shall be provided.</p> <p>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.</p>
3.00.00	INPUT/OUTPUT MODULES
3.01.00	The PLC system should be designed according to the location of the input/output cabinets as specified.
3.02.00	Input Output modules, as required in the Control System for all type of field input signals (4-20 mA, RTD, Thermocouple, non change over/change over type of contact inputs etc.) and outputs from the control system (non change over/change over type of contact, 24/48 VDC output signals for energising interface relays, 4-20 mA output etc.) are to be provided by the Contractor. Contractor to refer drawing nos. 0000-999-POI-A-065 for interface/termination requirements of Field Instruments/ Drives.
3.03.00	Electrical isolation of 1.5KV with optical couplers between the plant input/output and controller shall be provided on the I/O cards. The isolation shall ensure that any inadvertent voltage or voltage spikes (as may be encountered in a plant of this nature) shall not damage or mal-operate the internal processing equipment.
3.04.00	The Input/output system shall facilitate modular expansion in fixed stages. The individual input/output cards shall incorporate indications on the module front panels for displaying individual signal status.
3.05.00	Individually fused output circuits with the blower fuse indicator shall be provided. All input/output points shall be provided with status indicator. Input circuits shall be provided with fuses preferably for each input, alternatively suitable combination of inputs shall be done and provided with fuses such that for any fault, fuse failure shall affect the particular drive system only without affecting other systems.
3.06.00	All input/output cards shall have quick disconnect terminations allowing for card replacement without disconnection of external wiring and without switching of power supply.
3.07.00	<p>The Contractor shall provide the following monitoring features:</p> <p>a Power supply monitoring.</p>
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	<p>b Contact bounce filtering.</p> <p>c Optical isolation between input and output signals with the internal circuits</p> <p>d In case of power supply failure or hardware fault, the critical outputs shall be automatically switched to the fail-safe mode. The fail-safe mode shall be intimated to the successful Contractor during detailed engineering.</p>				
3.08.00	Binary Output modules shall be rated to switch ON/OFF coupling relays of approx. 3 VA at 24 VDC. Analog ouput modules shall be able to drive an load impedance of 500 Ohms minimum.				
3.09.00	Output module shall be capable of switching ON/OFF inductive loads like solenoid valves, auxiliary relays etc. without any extra hardware.				
3.10.00	Only one changeover contact shall be provided in MCC for control and interlock requirement. Further multiplication, if required ,shall be done by the contractor in PLC system.				
3.11.00	All input field interrogation voltage shall be 24V DC or 48 V DC.				
3.12.00	In case of loss of I/O communication link with the main processing unit, the I/O shall be able to go to predetermined fail safe mode (to be decided during detailed engineering) with proper alarm/message.				
3.13.00	Wiring Scheme for inputs to control system shall be as follows:				
3.13.01	Each of the triple redundant binary & analog inputs shall be wired to separate input modules. Similarly each of the dual redundant binary & analog inputs shall be wired to separate input modules. These redundant modules shall be placed in different racks, which will have separately fused power supply distribution. Implementation of multiple measurement schemes of these inputs will be performed in the redundant hardware. Loss of one input module shall not affect the signal to other modules. Other channels of these modules can be used by other inputs of the same functional group.				
3.13.02	The single (i.e. non-redundant) binary & analog signal required for control purposes shall be wired as follows:				
3.13.03	All single analog & binary inputs including the limit switches of valves/dampers MCC/SWGR check-backs of all drives & information related signals shall be wired to single (i.e. non-redundant) input modules.				
3.13.04	The on-off status of HT drives etc, however, be wired to two input modules in parallel.				
3.14.00	Binary & analog outputs shall be non-redundant only. Failure of any single module shall not affect operation of more than one single drive.				
<table><tr><td>NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE</td><td>TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2</td><td>PLANT AUXILIARY SYSTEM</td><td>PAGE 6 OF 14</td></tr></table>		NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2	PLANT AUXILIARY SYSTEM	PAGE 6 OF 14
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3.15.00	The signal conditioning functions like multiple measurement schemes, square root extraction for flow signals, pressure and temperature compensation, limit value computation can be performed either in the controllers or in signal conditioning and processing hardware outside controllers.																		
3.16.00	<p>The maximum number of inputs/outputs to be connected to each type of module shall be as follows:</p> <table><tr><td>1</td><td>: Analog input module</td><td>16</td></tr><tr><td>2</td><td>: Analog output module</td><td>16</td></tr><tr><td>3</td><td>: Binary input module</td><td>32</td></tr><tr><td>4</td><td>: Binary output module</td><td>32</td></tr><tr><td>5</td><td>: Analog input & output (combined)</td><td>16</td></tr><tr><td>6</td><td>: Binary input and output (combined)</td><td>32</td></tr></table> <p>Note: For binary inputs, one changeover contact is counted as 2 inputs.</p>	1	: Analog input module	16	2	: Analog output module	16	3	: Binary input module	32	4	: Binary output module	32	5	: Analog input & output (combined)	16	6	: Binary input and output (combined)	32
1	: Analog input module	16																	
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3	: Binary input module	32																	
4	: Binary output module	32																	
5	: Analog input & output (combined)	16																	
6	: Binary input and output (combined)	32																	
3.16.01	Any single sensor/transducer/transmitter failure alarm shall be provided on programmer station CRTs for all sensors/transducers/transmitters. Similarly sensor break alarm for thermocouples etc. shall also be displayed on the CRTs.																		
3.17.00	Contractor shall provide remote Input/Output modules Housed in free-standing cabinets/racks (with suitable redundant data link to the central PLC system) as specified. These Input/Output modules shall meet the technical requirements as mentioned in the above clauses. Further these Input/Output modules shall be designed to continuously work under the environment expected to be encountered in assigned areas without any air-conditioning support. Wherever the cable route distance of these I/O cabinets/racks exceeds a distance of 600 meters from the Central PLC, fiber optic data link has to be provided.																		
4.00.00	SYSTEM SPARE CAPACITY																		
4.01.01	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:																		
4.01.02	10% spare channels in input/output modules fully wired up to cabinets TB.																		
4.01.03	Wired-in "usable" space for 20% modules in each of the system cabinets for mounting electronic modules wired up to corresponding spare terminals in system cabinets. Empty slots between individual modules/group of modules, kept for ease in maintenance or for heat dissipation requirement as per standard practice of Contractor shall not be considered as wired-in "usable" space for I/O modules. Terminal assemblies (if any in the offered system), corresponding to the I/O modules shall be provided for above mentioned 20 % blank space.																		
<table><tr><td>NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE</td><td>TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2</td><td>4.00.00: PLANT AUXILIARY SYSTEM</td><td>PAGE 7 OF 14</td></tr></table>		NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2	4.00.00: PLANT AUXILIARY SYSTEM	PAGE 7 OF 14														
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4.01.04	Each processor / controller shall have 30% spare functional capacity to implement additional function blocks, over and above implemented logic/ loops. Further, each processor / controller shall have spare capacity to handle minimum 30% additional inputs/ outputs of each type including above specified spare requirements, over and above implemented capacity. Each of the corresponding communication controllers shall also have same spare capacity as that of processor/controller.		
4.01.05	The Data communication system shall have the capacity to handle the additions mentioned above.		
4.01.06	Twenty (20) percent spare relays of each type and rating mounted and wired in cabinets TB. All contacts of relays shall be terminated in terminal blocks of cabinets.		
4.01.07	The spare capacity as specified above shall be uniformly distributed throughout all cubicles. The system design shall ensure that above mentioned additions shall not require any additional controller/processor/ peripheral drivers in the system delivered at site. Further, these additions shall not deteriorate the system response time / duty cycle, etc. from those stipulated under this specification.		
5.00.00	DATA COMMUNICATION SYSTEM (DCS) — CUSTOMER SCOPE		
5.01.00	<p>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.</p> <p>The DCS shall have the following minimum features :</p> <ul style="list-style-type: none">a Redundant communication controllers shall be provided to handle the communication between I/O Modules (including remote I/O) and PLCs and between PLCs and operator work station.b The design shall be such as to minimise interruption of signals. It shall ensure that a single failure anywhere in the media shall cause no more than a single message to be disrupted and that message shall automatically be retransmitted. Any failure or physical removal of any station/module connected to the system bus shall not result in loss of any communication function to and from any other station/module.c If the system bus requires a master bus controller philosophy, it shall employ redundant master bus controller with automatic switchover facility.d 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.		
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	<p>f Data transmitting speed shall be sufficient to meet the responses of the system in terms of displays, control etc. plus 25% spare capacity shall be available for future expansion.</p> <p>g Passive coaxial cables or fiber optic cables shall be employed.</p> <p>The Contractor shall furnish details regarding the communication system like communication protocol, bus utilisation calculations etc.</p>				
5.02.00	<p>The PLC system shall be provided with necessary interface hardware and software for dual fiber optic connectivity & interconnection with station wide LAN (In Employer's Scope)for two - way transfer of signals for the purpose of information sharing. The plant information shall be made available through an Ethernet link following TCP/IP standard. The system shall be OPC compliant. The exact data structure shall be as decided during detailed engg. All required plant data shall be transferred to/from through this ensuring complete security. The exact number of points to be transferred through the above communication link and the format of the data shall be finalised during detailed engineering. The Contractor shall provide all assistance to the BOP C&I System (In Employer's Scope) Supplier including co-ordination and flow of required information etc. for display of all input points under alarm, connected to PLC or generated by PLC, on various operating stations on BOP C&I System and various client PCs on station LAN.</p>				
6.00.00	SYSTEM REACTION TIME				
6.01.00	<p>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.</p>				
7.00.00	OPERATOR INTERFACE DISPLAYS/LOGS/REPORTS				
	<p>Suitable Operator Interface Displays/Logs/Reports for control operation & monitoring shall be provided. The details shall be finalised during detailed Engg. Stage.</p>				
7.01.01	<p>Historical storage and retrieval system (HSRS)</p>				
7.01.02	<p>The HSRS shall collect store and process system data from MMIPIS data base. The data shall be saved online on hard disk and automatically transferred to erasable long term storage media once in every 24 hours periodically for long term storage. Provision shall be made to notify the operator when hard disk is certain percentage full. The disk capacity shall be sufficient to store at least seven days data.</p>				
7.01.03	<p>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</p>				
<table><tr><td>NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE</td><td>TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2</td><td>THE PLANT AUXILIARY SYSTEM</td><td>PAGE 9 OF 14</td></tr></table>		NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2	THE PLANT AUXILIARY SYSTEM	PAGE 9 OF 14
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	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.
7.01.04	<p>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.</p>
	<p>The system shall have provision of generation. Of reports and logs. General only two types of logs shall be.</p>
7.01.05	<p>Reports and Logs:-</p> <p>The system shall have provision of generation of reports and logs. Generally two types of logs shall be provided.</p> <p>i) Time dependant - Periodically generated (shift log, daily log etc.).</p> <p>ii) Event dependant -</p> <p>Provision of thirty logs/reports of each type shall be provided.</p>
8.00.00	CONTROL & POWER SUPPLY SCHEME
8.01.00	<p>For Control system, redundant power supply shall be provided by the contractor. Necessary redundant transformers and redundant chargers with battery back-up shall be provided by the Contractor to derive power supply from 415 V, 3-phase 3-wire incomers to be arranged by the Contractor at the input terminals of Power supply cabinets. The Contractor shall, however, furnish all required hardware/ equipment/ cubicles for conversion and/or stabilisation of the power source provided by the Owner to all other levels which may be necessary for meeting the individual requirements of equipments/ systems furnished by him within the Contractor's quoted lump sum price. Power supply module shall be of ample capacity to supply all modules. In addition 20% spare capacity for future shall be provided. All the drives shall be switched ON/OFF through 24V DC coupling relays to be provided in HT/LT SWGR panels. Power supply distribution from Contractor's power supply cabinets shall be in the scope of Contractor. The exact power supply scheme shall be as approved by Employer during detailed Engineering stage.</p>
8.02.00	<p>The battery shall be sealed maintenance free Ni-Cd type batteries with long life and shall be able to provide a back-up for one hour at full load requirement of the complete control system.</p>
8.03.00	<p>The equipment of power supply unit can be mounted as an integral part of the enclosure and the same shall provide all voltages necessary to power the processor and I/O modules. All required redundant power packs etc. with inbuilt chargers, with minimum thirty minutes battery back-up shall be provided .Power supply module shall be of ample capacity to supply all modules. In addition 20% spare capacity for</p>
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	future shall be provided. However, the exact power supply scheme shall be as approved by Employer during detailed Engineering stage.		
9.00.00	CONTROL CABINETS / PANELS / DESKS		
9.01.00	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.		
9.01.01	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.		
9.01.02	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.		
9.01.03	Cabinet doors shall be hinged and shall have turned back edges and additional bracing where required ensuring rigidity. Hinges shall be of concealed type. Door latches shall be of three-point type to assure tight closing. Detachable lifting eyes or angles shall be furnished at the top of each separately shipped section and all necessary provisions shall be made to facilitate handling without damage. Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is more than 800 mm, double doors shall be provided.		
9.01.04	<p>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:</p> <p>(a.) Exterior:- As per RAL 9002 (End panel sides RAL 5012), to be finalised during detailed engineering.</p> <p>(b.) Interior:- Same as above.</p> <p>Paint films which show sags, checks or other imperfections shall not be acceptable.</p>		
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2	PLANT AUXILIARY SYSTEM
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CLAUSE NO.	TECHNICAL REQUIREMENTS
	<p>As an alternative, single coat of anodic dip coat primer along with single textured powder coating with epoxy polyester meeting the thickness requirement is also acceptable.</p> <p>The Bidder shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory painted surfaces of each item of equipment. The touch-up paint shall be of the same type and color as the factory applied paint and shall be carefully packed to avoid damage during shipment. Complete painting instructions shall be furnished.</p>
9.01.05	Refer Subsection Basic Design Criteria, Part B, Section VI for grounding requirements.
9.02.00	The technical specification covering panel fabrication details, wiring and termination details etc. shall be as described under Sub-Section INST CABLE of this specification.
9.03.00	Control Desk
9.03.01	PC based OWS (operator Work Station) of PLC shall be mounted on table type control desk to house PC/ keyboards/ mouse etc. Control desk shall be free standing table top type with doors at the back and shall be constructed of 3 mm thick CRCA steel plates. A 34 mm thick wooden top shall be provided on the desk with proper finish of acrylic PVC/polyutherane paint. All operators work stations shall be mounted on this Control Desk. Employer supplied PA system hand sets, telephone sets and CCTV monitors shall also be mounted. The Keyboard shall be capable of being pulled out through a tray. The desk shall be arranged in an continuous arc shape. The exact profile of the desk, dimension and the radius of curvature shall be finalised during detailed engineering stage.
9.03.02	To achieve durable & water resistant finish, a coat of "Polyuthesive crystal clear" on the surface of unit control desks shall be provided. Final paint finish with proper smoothing is to be ensured. Final finish of Control Desk should be in line with relevant International standards.
9.03.03	Two nos industrial grade chairs will be provided with control desk.
10.00.00	ANNUNCIATION SYSTEM
10.01.00	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.
10.02.00	The system shall display history of alarms in chronological order on any of the OWS. The HMIS shall have the capability to store a minimum of 500 alarms each with paging features allowing the operator to view any page. The system shall have all alarm functions and related function keys like alarm acknowledge, reset, paging, summaries etc. Other design features like set point/dead band adjustments, provision of alarm priority, manual inhibition & automatic inhibition based on predefined logic etc., shall be provided and shall be as finalised during detailed engineering. The alarm display/report format shall be as approved by the Employer.
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Main memory	1 GB expandable to 4 GB		
	Drives	3 1/2" floppy drive, 48 x CD ROM drive		
	Hard disk	40 GB		
	Removable bulk storage drive (MOD / DVD / DAT)	6 GB (minimum)		
	Removable Bulk Storage Media for above	10 nos		
	Monitor	19" Full Flat TFT Resolution 1280 x 1024, refresh rate min 85 Hz.		
	Graphic Memory	16 MB		
	Communication port	2 serial plus, one parallel, 8 USB port, Dual 100 Mbps Ethernet.		
	Expansion slots	3		
	Other Features	101 Keys Keyboard and Optical Mouse		
	UPS	1 no. on-line Intelligent UPS with 30 mins. battery backup on machine load (for PC & its printer) and remote monitoring are to be provided for each PC and PC based OWS.		
	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		
12.00.00	PRINTER			
	One number A4 size color laser printer per PLC shall be provided as a part of the HMIS system, specifications of which shall be as 'DDCMIS' system.			
13.00.00	TRAINING			
	Contractor shall provide training on PLC systems for Employee personnel. The exact duration of the training shall be as per Part-C, Section-VI.			
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2	PLANT PLANT AUXILIARY SYSTEM	PAGE 14 OF 14

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CLAUSE NO.	TECHNICAL REQUIREMENTS
MEASURING INSTRUMENTS	
1.00.00	MEASURING INSTRUMENTS
1.01.00	Measuring instruments/equipment and subsystems offered by the Bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Refer Sub-section Basic Design Criteria. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance. They shall comply with the acceptable international standards and shall be subject to Employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specifications, ranges, makes/numbers as approved by the Employer during detailed engineering.
1.02.00	Every panel-mounted instrument requiring power supply shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.
1.03.00	All local gauges as well as transmitters, sensors, and switches for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance as well as for operator and management information (including all computation) of equipment under the scope of specification shall be provided on as required basis within the quoted lump sum price. For bidding purpose, tentative minimum instruments have been indicated on the P&IDs. However, contractor shall supply any additional local gauges/switches/transmitters/sensors for reasons mentioned above without any additional cost to the Employer.
1.04.00	The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments, sensors; switches etc. for external connection including spare contacts shall be wired out in flexible/rigid conduits, independently to suitably located common junction boxes. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm.
1.05.00	For all instruments envisaged for sea water applications they shall be provided with wetted parts made of Monel / Hastelloy C or any other material (if provenness experience of the proposed material for such applications is established by contractor:
1.06.00	All instruments shall be provided with durable epoxy coating for housings and all exposed surfaces of the instruments.
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.00.00	SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, D.P., FLOW AND LEVEL		
	ELECTRONIC TRANSMITTERS		
	Sl.No.	Features	Essential/Minimum Requirements
	1.	Type of Transmitter	Microprocessor based 2 wire type, Hart protocol compatible.
	2.	Accuracy	± 0.1% of calibrated span (minimum)
	3.	Output signal range	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol)
	4.	Turn down ratio	10:1 for vacuum/very low pressure applications. 30:1 for other applications.
	5.	Stability	± 0.1% of calibrated span for six months for Ranges up to and including 70 Kg/cm². ± 0.25% of calibrated span for six months for Ranges more than 70 Kg/cm² (g).
	6.	Zero and span drift	+/- 0.015% per deg.C at max span. +/-0.11% per deg.C at min. Span.
	7.	Load impedance	500 ohm (min.)
	8.	Housing	Weather proof as per IP-55 with durable corrosion resistant epoxy coating.
	9.	Over Pressure	150% of max. Operating pressure
	10.	Connection (Electrical)	Plug and socket type
	11.	Process connection	1/2 inch NPT (F)
12.	Span and Zero	Continuous, tamper proof, Remote as well as adjustability manual from instrument with zero suppression and elevation facility.	
13.	Accessories	-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition.	
<div>NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE</div>			
<div>TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2</div>			
<div>SECTION-IV MEASURING INSTRUMENTS</div>			
<div>PAGE 2 OF 17</div>			

CLAUSE NO.	TECHNICAL REQUIREMENTS						
2.01.00	<p>-2 valve manifold for absolute pressure transmitters (3-valve manifold for gauge/ vacuum pressure transmitters) and 5 valve manifold for DP/level/flow transmitters.</p> <p>-For hazardous area, explosions proof enclosure as described in NEC article 500.</p>						
	14.	Diagnostics	Self Indicating feature				
	15.	Power supply	24V DC \pm 10%.				
	16.	Adjustment/calibration/maintenance	Centralised PC based system (In Employer's Scope). In addition total two (2) no. of hand- held type universal calibrators per unit, compatible with HART protocol, shall be provided.				
	<p>Notes</p> <p>In case it becomes necessary to use a DP transmitter for pressure measurement then a 3-valve manifold should be used in place of 2-valve manifold.</p> <p>LVDT type is not acceptable.</p> <p>Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.</p>						
	<p>Ultrasonic Type level Transmitter</p>						
	Sl. no	Features	Essential/Minimum requirements				
	1.	Type of Transmitter	Non contact Microprocessor based 2 wire type, HART protocol compatible Ultrasonic transmitter.				
	2.	Output signal	Galvanic ally isolated 4-20mA DC (Analog) along with superimposed digital signal (based on HART protocol).				
	3.	Sensor Accuracy	+/- 0.5% of calibrated span.				
4.	Sensor Repeatability	3 mm or better.					
5.	Power supply	24 V DC +/- 10%					
6.	Temperature compensation	To be provided within transducer.					
<table><tr><td>NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE</td><td>TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2</td><td>MEASURING MEASURING INSTRUMENTS</td><td>PAGE 3 OF 17</td></tr></table>				NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2	MEASURING MEASURING INSTRUMENTS	PAGE 3 OF 17
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	7.	Configuration	Sensor unit and Electronic units are to be separate. It shall be possible to mount the Electronic unit at a remote accessible location from the transducer. All cables and weather proof fittings to interconnect transducer to electronic unit shall be provided by Bidder.	
	8.	Housing	Weather proof as per IP-55 with durable corrosion resistant epoxy coating.	
	9.	Calibration	Through HART Communicator.	
	10.	Zero and Span adjustment	Continuous, tamper proof, remote as well as manual adjustability from instrument. It shall be possible to calibrate the instrument without any level in the tank/sump etc	
	11.	Sensor Material	Corrosion resistant material to suit individual application requirement.	
	12.	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	
	13.	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	
	14.	Display	Minimum 4 character display with integral keypad, access protected by user code.	
	15.	Diagnostics	Loss of echo alarm etc	
	16.	Load Impedance	500 ohms minimum	
	17.	Electrical Connection	Plug and socket	
	18.	Accessories	<ul style="list-style-type: none">• All weather canopy for protection from direct sunlight and direct rain.• All mounting hardware and accessories required for erection and commissioning mounting fittings material shall be SS 316.• For hazardous areas, explosion proof enclosure as described in NEC article 500.	
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2	III-C 04: MEASURING INSTRUMENTS	PAGE 4 OF 17

CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.00.00	TEMPERATURE ELEMENTS		
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 type).
	2	No. of element	: Duplex
	3	Housing/Head	: IP-55/Diecast Aluminium. Plug in connectors are to be provided for external signal cable connection.
	4	Sheathing of Thermocouple	: Swaged type magnesium oxide insulation.
	5	Calibration and accuracy	: As per IEC-751/ANSI-C-96.1(special class)for T/C.
	6	Characteristic	: Linear with respect to temp, within ±1/2 percent of top range value.
	7	Accessories	: Thermo well (as specified below) and shall be spring loaded for positive contacts with the well.
	8	Standard	: ANSI C 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-55/Diecast Aluminium. Plug in connectors are to be provided for external signal cable connection.
	4	Sheathing of RTD	: Metal sheathed, ceramic packed
	5	Calibration and accuracy	: As per DIN-43760 Class-A for RTD
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.03.00	6 Characteristic	:	Linear with respect to temp, within $\pm 1/2$ percent of top range value.
	7 Accessories	:	Thermo well (as specified below) and shall be spring loaded for positive contacts with the well.
	8 Standard	:	DIN-43760 for RTD and ASME PTC-19.3 for Thermo-well.
	Metal Temperature Thermocouples		
	Measuring Medium		Metal Temperature
	Material of Thermocouple.		Chromel Alumel Type K
	Type of Thermocouple		Duplex with separate hot junctions, ungrounded
	Insulation		Mineral Insulation Magnesium Oxide.
	Thermocouple wire gauge		16 AWG
	Protective sheath		SS 321
	Protective sheath dia		8 mm O.D
	Characteristics of Thermocouple		Special limits of error as in ANSI thermocouple MC 96.01.1975
	Mounting accessories		1/2" BSP SS sliding end connector, weld pad, clamps of heat resistant steel SS310.
	Cold end sealing		SS pot weal with colour coded PTFE headed sleeve Insulated flexible tails. Sealing compound-Epoxy resin.
	Minimum bending radius		30 mm
	Length of T/C		30 Mtr. (minimum)
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.04.00	<p>Thermo well (for all process temp. elements)</p> <p>(a) Shall be one piece solid bored type of 315 SS of step-less tapered design. (As per ASME PTC 19.3 1974)</p> <p>(b) For Mill classifier outlet long life solid sintered tungsten carbide material of high abrasion resistance shall be provided.</p> <p>(c) For Air & Flue gas 316 SS protecting tube with welded cap. (However contractor shall provide better material for Flue gas service if require based on the specify boiler design parameters).</p> <p>(d) For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges.</p>		
4.00.00	<p>TEMPERATURE TRANSMITTER</p> <p>Following types of 2-wire temperature transmitter (directly powered from 4-20mA input cards of DDCMIS) shall be provided. The temperature transmitter shall be fully compatible with thermocouples and RTDs being provided by the contractor. Temperature compensation of the thermocouples shall be performed in the temperature transmitter itself.</p> <p>a. Single Input Head mounted Temperature Transmitter</p> <p>These shall be suitable for mounting in the head of temperature element itself. The protection class of head of thermo well along with its plug-in connector shall be min. IP65.</p> <p>b. Single Input DIN-rail mounted Temperature Transmitter</p> <p>These shall be suitable for mounting on DIN-rails in JB's. The specifications of the JB's shall be same as indicated in Subsection INST CABLE with additional DIN-rails and IP 65 Protection class. This temperature transmitter shall be the ones which are especially designed for DIN-rail mounting with IP 20 protection class. These shall have terminals for input/output provided on front side when mounted on DIN-rail. Head mounted temperature transmitter with clamps to make it suitable for DIN-rail mounting shall not be acceptable under this category.</p> <p>c. Dual-input Temperature Transmitter With Indicator:</p> <p>These shall be suitable for mounting on pipes/ support. These shall be provided for temperature measurement which are used for tripping /protection of auxiliaries e.g. for bearing temperature on which trip is envisaged. Indicator shall be provided with these transmitters. These transmitters shall have bump less change over facility to second sensor in case first sensor fails .This change-over is to be alarmed. Protection class shall be IP65 minimum.</p>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS
	<p>d. Common requirements for each of the above type of temperature transmitters</p> <p>Output : 2-wire (power supply from input card of Control System) with 4-20mA output with superimposed HART protocol signal.</p> <p>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)</p> <p>Isolation : min. 500 V AC</p> <p>EMC compatibility : as per EN 61326</p> <p>Operating ambient temperature : 0 to 85 deg C (without indicator) 0 to 70 deg C (with indicator)</p> <p>Power supply compatible with input module of Control System</p> <p>Accessories Mounting arrangements including clamps etc.</p> <p>Composite Accuracy (a) For head mounted and DIN-rail mounted types:</p> <p>(Refer note 2) RTD = <0.4% of 0-250 deg C span T/C-K type = <0.4% of 0-600 deg C span T/C-R type = <0.4% of 0-1000 deg C span CJC accuracy (for thermocouples) shall be = < 1 deg C</p> <p>(b) For dual-input type: RTD = <0.25% of 0-250 deg C span T/C-K type = <0.2% of 0-600 deg C span CJC accuracy (for thermocouples) shall be = < 1 deg C</p> <p>Notes:-</p> <p>1. In case of failure (open or burn-out) of RTD/thermocouple, temp. transmitter shall provide low temperature output.</p>
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CLAUSE NO.	TECHNICAL REQUIREMENTS																														
	<p>2. Composite Accuracy is to be calculated as summation of all applicable accuracies of temp transmitter, for converting sensor input to output in 4-20 mA (e.g., basic accuracy, digital accuracy, D/A accuracy, etc.) and temperature effect on these accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of Temperature Elements specified. All such accuracy/ temp effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures.</p> <p>e. Field bus compatible temperature Transmitters (For Generator Temperature measurement applications)</p> <p>Minimum requirements shall be as follows:-</p> <p>Temperature signals shall be acquired using modular system consisting of I/O modules, power supply modules, field terminals and Bus Interface modules. The signals from the field shall be terminated in Terminal blocks using Cage clamp type connection. Input modules (as described below) shall acquire these process signals which shall be converted to field bus compatible signals using Bus interface modules to transfer data to DDCMIS system. Bus interface modules shall be able to support field bus protocols like PROFIBUS, Foundation Field bus etc. All the above modules shall be mounted in a Junction box. Degree of protection for this JB shall be IP 67. However, process signals shall be terminated separately using terminal blocks before entering the modular system.</p> <table><tr><th>Sl no</th><th>Features</th><th>Minimum requirement</th></tr><tr><td>1</td><td>Input</td><td>K-type T/c, Pt 100 RTD</td></tr><tr><td>2</td><td>CJC Compensation</td><td>Integral</td></tr><tr><td>3</td><td>Accuracy</td><td>Minimum 0.4% at 23 deg C or better</td></tr><tr><td>4.</td><td>Operating temperature</td><td>0-55 deg c</td></tr><tr><td>5</td><td>Diagnostics</td><td>Wire break monitoring, Power supply healthiness etc</td></tr><tr><td>6</td><td>Mounting</td><td>DIN rail mounted</td></tr><tr><td>7</td><td>Accessories</td><td>All required accessories shall be provided.</td></tr><tr><td>8</td><td>Power supply</td><td>24 VDC</td></tr><tr><td>9</td><td>EMC</td><td>EN 50081/EN50082 or equivalent</td></tr></table>	Sl no	Features	Minimum requirement	1	Input	K-type T/c, Pt 100 RTD	2	CJC Compensation	Integral	3	Accuracy	Minimum 0.4% at 23 deg C or better	4.	Operating temperature	0-55 deg c	5	Diagnostics	Wire break monitoring, Power supply healthiness etc	6	Mounting	DIN rail mounted	7	Accessories	All required accessories shall be provided.	8	Power supply	24 VDC	9	EMC	EN 50081/EN50082 or equivalent
Sl no	Features	Minimum requirement																													
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CLAUSE NO.	TECHNICAL REQUIREMENTS
5.00.00	<p>ANALYSER INSTRUMENTS:</p> <p>Common Requirements</p> <ol style="list-style-type: none"> 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 transmission Signal 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 (In Employer's Scope).
5.01.00	<p>Hydrogen Analyser</p> <ol style="list-style-type: none"> 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)
<p>NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE</p>	<p>TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2</p> <p>TITLE 4: MEASURING INSTRUMENTS</p> <p>PAGE 10 OF 17</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.02.00	9. Error Diagnostic	To be provided		
	10 Repeatability	± 1% of calibrated span		
	11 Linearity	± 2% of calibrated span		
	PH Analyser			
	1. TYPE	CELL - FLOW THROUGH		
	2. ACCURACY	< ± 1% OF SPAN		
	3. RANGE	0 - 14 PH, PROGRAMMABLE		
	4. NO. OF STEAMS	SINGLE		
	5. STABILITY	< 0.001 PH / WEEK		
	6. TEMP. COEFFICIENT / TEMP. ERROR	0.001 PH / DEG. C		
6.00.00	7. TYPE OF ELECTRONICS	MICROPROCESSOR BASED WITH SELF-DIAGNOSTIC FACILITY.		
	8. INDICATION	DIGITAL		
	9. ENCLOSURE	WEATHER DUST PROOF (IP55) DIE CAST ALUMINUM.		
	SPECIFICATION FOR FLOW ELEMENTS			
	6.01.00 Orifice Plate			
	Features	Essential/Minimum Requirements		
	Type	Concentric as per ASME PTC-19.5 (Part-II), ISA RP-3.2, 1960 or BS-1042		
	Material	316 SS		
	Thickness	3 mm for main pipe diameter up to 300 mm and 6 mm for main pipe dia above 300 mm.		
6.01.00	Material of branch pipe	Same as main pipe		
	Root valve type	Globe		
	Root valve material	316 SS		
	Root valve size	1 inch		
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2	 MCS: MEASURING INSTRUMENTS	PAGE 11 OF 17


CLAUSE NO.	TECHNICAL REQUIREMENTS
6.02.00	<p>Impulse pipe of same material up to root valve Required</p> <p>Tappings Flanged weld neck. 3 pairs. of tapping.</p> <p>Beta Ratio 0.34 to 0.7</p> <p>Beta Ratio calculation to be submitted Yes</p> <p>Assembly drg. and flow Vs DP Curves Yes</p> <p>Accessories Root valves, flanges, Vent/drain hole(As required)</p> <p>Contractor shall submit certified flow calculation and differential pressure vs. flow curves for each element for Employer's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Employer's approval. One Flow element of each type shall be calibrated in the test laboratory for validation of commutated flow calculations.</p>
	<p>Flow Nozzle</p> <p>Features Essential/Minimum Requirements</p> <p>Type Long radius, welded type as per ASME PTC-19.5 (Part-III) or BS-1042</p> <p>Material 316 SS</p> <p>Thickness Suitable for intended application.</p> <p>Material of branch pipe Same as main pipe</p> <p>Root valve type Globe</p> <p>Root valve material 316 SS</p> <p>Root valve size 1 inch</p> <p>Impulse pipe of same material up to root valve Required</p> <p>Tapping D and D/2 (3 sets of tapings points)</p> <p>Beta Ratio Around 0.7</p> <p>Beta Ratio calculation to be submitted Yes</p>
<p>NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE</p>	
<p>TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2</p>	
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
7.00.00	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. One Flow element of each type shall be calibrated in the test laboratory for validation of computed flow calculations.				
	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.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	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
8.00.00	Notes:-			
	*Bicolour type level gauges will be provided for applications involving steam and water except for condensate and feed water services.			
	Length of gauge glass shall not be more than 1400 mm. If the vessel is higher, multiple gauge glasses with 50 mm overlapping shall be provided.			
	Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.			
	ROTAMETERS			
	SR. NO.	FEATURES	ESSENTIAL / MINIMUM REQUIREMENTS	
	1.	TYPE	VARIABLE AREA METAL TUBE	
	2.	FLUID MEDIA	WATER/OIL	
	3.	TUBE BODY	SS316	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
9.00.00	<p>4. MATERIAL OF 316 SS FLOAT</p> <p>5. INDICATOR LINEAR SCALE</p> <p>6. ACCESSORIES FLANGE, ORIFICE IN CASE OF BYPASS ROTA METER (FOR LINE SIZE ABOVE 100 MM)</p> <p>7. HOUSING PROTECTION IP-55 CLASS</p> <p>8. ACCURACY $\pm 2\%$ OF MEASURED VALUE.</p>			
	PROCESS ACTUATED SWITCHES			
	FEATURES ESSENTIAL / MINIMUM REQUIREMENTS			
		Pressure/ Draft Switches/ DP Switches	Temperature switches	Level switches
	Sensing Element	Piston actuated for high pressure and diaphragm or bellows for low pr./ vacuum	Vapor pressure sensing, liquid filled bellow type with SS bulb and capillary (10 m minimum)	Capacitance types for oil and dirty medium, water, condensate application. Float type switches for applications as decided by Employer during detailed engineering. Capacitance/ Conductivity/ Ultrasonic type for acid and alkali application. Radio-frequency/ Ultrasonic type for ash hopper, ash slurry application.
	Material	316 SS	Bulb 316 SS/ capillary 304 SS	316 SS
	End connection	½ inch NPT (F)	½ inch NPT (F)	Manufacturer standard
	Over range proof pressure	150% of max. design pr.	-	150% of max. design pressure
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CLAUSE NO.	TECHNICAL REQUIREMENTS
10.00.00	<p>Repeatability $\pm 0.5\%$ of full range</p> <p>No. of contacts 2 No.+2NC. SPDT snap action dry contact</p> <p>Rating of contacts 60 V DC, 6 VA (or more if required by DDCMIS)</p> <p>Elect. Connection Plug in socket.</p> <p>Set point/ dead band adjustment Provided over full range.</p> <p>Enclosure Weather and dust proof as per IP-55</p> <p>Accessories Siphon, snubber, chemical seal, pulsation dampeners as required by process Thermo well of 316 SS and packing glands All mounting accessories</p> <p>Mounting Suitable for enclosure/ rack mounting or direct mounting Suitable for rack mounting or direct mounting -</p> <p>Power Supply (wherever required) 24 V DC, to be arranged by Contractor except for Ash Level Switches, where the same shall be as per Contractor's Standard practice.</p> <p>Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.</p> <p>DEW POINT METER</p> <p>Sensor</p> <p>Type : Capacitance type with change in output proportional to moisture present.</p>
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CLAUSE NO.	TECHNICAL REQUIREMENTS
	<p>Service : Dry Air</p> <p>Range : -50 to 0 Degree Centigrade Dew-Point</p> <p>Sensor Accuracy : Better than +/-0.5^</p> <p>Operating Temperature : 0 to 50 degree C.</p> <p>Operating Pressure : 0-10 Kg./Cm2, suitable for process application.</p> <p>Analyser</p> <p>Input : Change in capacitance from dew point sensor.</p> <p>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.</p> <p>Range : -50 to 0 Degree Centigrade Dew-Point</p> <p>Display Accuracy : Better than +/-2 Degree C.</p> <p>Mounting : Table top/Flush mounting, to be finalised during detailed engineering.</p> <p>Power supply : 240V AC, 50 Hz to be arranged by the contractor.</p> <p>Output : 5-20 mA DC capable of driving a load impedance of 500 ohms minimum.</p> <p>4-20 mA DC Output signal is to be connected to control system in Contractor's Scope (Interconnection cables are to be provided by the Contractor).</p> <p>In case the system is not suitable for Direct online mounting, then all the required sampling system is to be provided by the contractor.</p> <p>All required accessories including cables, sensor holder, desiccant chambers, mounting fixtures etc. are to be supplied by the Contractor within his quoted lumpsum price.</p>
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CLAUSE NO.	TECHNICAL REQUIREMENTS
4.00.00	PIPING/TUBING SUPPORT
4.01.00	Impulse piping and sample piping shall be supported at an interval not exceeding 1.5 meters. Each pipe shall be supported individually using slotted angle mounted clamps with necessary fixtures. Tubing shall run in proper perforated trays with proper cover. Tubing shall be supported inside the trays by aluminium supports. Hangers and other fixtures required for support of piping and trays shall be provided, either by welding or by bolting on walls, ceilings and structures. Hanger clamps and other fastening hardware shall be of corrosion resistant metals and hot-dip galvanized.
5.00.00	SHOP AND SITE TESTS
5.01.00	General Requirements
5.01.01	The equipment and work performed as per this Sub-section shall be subject to shop and site test as per requirements of Sub-section-Q (Quality Assurance & Inspection) other applicable clauses of this Sub-section and Employer approved quality assurance plan.
5.01.02	Hydrostatic and pneumatic tests shall be performed on all pipes, tubing and systems and shall conform to ANSI B31.1.
5.02.00	Hydrostatic Testing
5.02.01	All instrument piping/ tubing shall be hydrostatically tested upon completion of erection. The test pressure shall be 1.5 times the maximum process pressure. The test shall be performed either with the testing of associated process piping or without the associated process piping (by closing the root valve). In both the cases the instrument shall be isolated by closing the shut-off valve.
5.03.00	Air Testing
5.03.01	All air headers & branch pipes shall be air tested by pressure decay method as per ANSI B31.1. Flexible hoses and short signal tubing shall be tested at normal pressure for leakage. Long signal tubing shall be tested by charging each tube with air at 2 kg/ sq. cm. through a bubbler sight glass. The boiler draft and vacuum piping shall be air tested by the same method as long signal tubing.
6.00.00	LOCAL INSTRUMENT ENCLOSURE AND RACKS Transmitters and switches, devices, etc. (except for all fuel oil applications which shall be mounted close to be tapping points) mounted in the field shall be suitably grouped together and mounted (i) local instruments enclosure in case of open areas of the plant like boiler area, etc. and (ii) In local instrument racks in case of covered areas. Gauges are to be mounted on a channel or a frame or a rack (Gauges shall not be mounted directly in process pipe). These local instrument enclosures and racks shall be furnished as per the actual requirements finalised during detailed engineering stage. The exact grouping of instruments in a particular
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CLAUSE NO.	TECHNICAL REQUIREMENTS
	<p>instrument enclosure/instrument rack shall be as finalised during detailed engineering stage subject to Employer's approval.</p> <p>LIEs / LIRs shall be of three types depending on the number of transmitters located in it as elaborated in the typical GA of the LIE/LIR, drawing no. 0000-999-POI-A-064. These dimensions and number of instruments indicated therein are only indicative and the exact dimensions along with the number of instruments shall be as finalised during detailed engineering stage without any price repercussions.</p> <p>The internal layout shall be such that the impulse piping/ blow down lines are accessible from back side of the enclosure / rack and the transmitters etc. are accessible from front side for easy maintenance. Bulkheads, especially designed to provide isolation from process line vibration shall be installed on instrument enclosures/racks to meet the process sensing line connection requirement.</p> <p>Vibration dampeners shall be installed for each enclosure / rack.</p> <p>The enclosures shall be constructed of 3 mm sheet plate and shall be of modular construction with one or more modules and two end assemblies bolted together to form an enclosure. Double inter locking doors shall be provided. The doors shall be the three-point locking type constructed of not less than 1.6 mm thick steel. Doors shall have concealed quick removal type pinned hinges and locking handles. Door locks shall accept the same key.</p> <p>Gaskets shall be used between all mating sections to achieve protection class of IP-55.</p> <p>The instrument racks shall be free standing type constructed of suitable 5 mm thick channel frame of steel and shall be provided with a canopy to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel, and extended beyond the ends of the rack. Bulk heads, especially designed to provide isolation from process line vibration shall be provided. Exact fabrication details shall be as finalised during detailed engineering stage. The junction box for racks also shall conform to IP 55 protection class.</p> <p>Enclosures/racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein. Centre posts or any member which would reduce access shall not be provided.</p> <p>Each transmitter enclosure housing instruments requiring purge air for continuous air purging, shall be provided with common purge air header, redundant air filter regulators of sufficient capacity, required pressure gauges, valves, fittings, SS tubings and individual purge meters for each purge line etc. as required and indicated in Instrument Installation drawings enclosed herewith.</p> <p>A 15 mm NB service air header shall be furnished in each instrument enclosure housing air & flue gas and coal mill instruments. The header shall be furnished complete with a pressure regulating valve, pressure gauge, and quick disconnect connections. A hose for connecting each header to the draft instrument line four-way valves shall be furnished. The hose shall be self-storing nylon tubing having a burst pressure of 15 kg/sq.cm. The size of the hose shall be 1/2" minimum. The</p>
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CLAUSE NO.	TECHNICAL REQUIREMENTS
	<p>service air header shall originate at a bulkhead penetration or fitting located on one of the bulkhead plates.</p> <p>The contractor shall prepare the piping drawings and the general arrangement layout drawings for each of the enclosures and racks. Special attention shall be given in the piping layout to avoid air traps in liquid filled piping or water pockets in piping intended to be dry. Drawings shall indicate the arrangement of all equipment, piping, valves and fittings within, the enclosure/racks and shall be subject to Employer's approval.</p> <p>All liquid filled blow down lines, except those measuring vacuum shall be connected to a two inch header which is extended through one end of the enclosure and turned downward for directing the blow down into a drain. The material of the blow down header shall be carbon steel as per ASTM A 106 Gr C.</p> <p>The Contractor shall submit to the Employer with his proposal a copy of his welding procedure specification together with proof of his compliance with the latest applicable welding ANSI code. Prior to any welding being performed, the Contractor shall submit the qualifications of the craftsmen who will perform the work.</p>
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	INSTRUMENTATION AND POWER SUPPLY CABLE			
1.00.00	INSTRUMENTATION CABLE, POWER SUPPLY CABLE, INTERNAL WIRING AND ELECTRICAL FIELD CONSTRUCTION MATERIAL			
1.01.00	General Requirements			
1.01.01	All cables including special cables, internal wiring and electrical field construction material shall conform to this specification, Employer approved detail engineering drawings & documents and the latest edition of the relevant standards & guidelines. The Bidder shall furnish all material and services required for the completeness of the work identified in his scope as per this specification.			
1.01.01	The Contractor shall supply, erect, terminate and test all instrumentation cables for control and instrumentation equipment/devices/systems included under Contractor's scope as illustrated in the enclosed Drg. No. 0270-110-POI-A-021 and ensuring completeness of the control system.			
1.01.02	Any other application where it is felt that instrumentation cables are required due to system/operating condition requirements, are also to be provided by Contractor.			
1.01.03	Other type of cables like -fiber optic/co-axial cables for system bus, cables for connection of peripherals etc. (under Contractor's scope) are also to be furnished by the Contractor.			
1.01.04	Contractor shall supply all cable erection and laying hardware from the main trunk routes like branch cable trays/sub-trays, supports, flexible conduits, cable glands, lugs, pull boxes etc. on as required basis for all the systems covered under this specification.			
1.01.05	Wherever the quantity has been defined as on as required basis, the same are to be furnished by contractor on as required basis within his quoted lump sum price without any further cost implication to the Owner.			
2.00.00	Specification of Instrumentation cable			
2.01.00	Common Requirements			
	S. No.	Property	Requirement	
	1	Voltage grade	225 V (peak value)	
	2.	Codes and standard	All instrumentation cables shall comply with VDE 0815, VDE 0207, Part 4, Part 5, Part 6, VDE 0816, VDE 0472, SEN 4241475, ANSI MC 96.1, IS-8784, IS-10810 (latest editions) and their amendments read along with this specification.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
2.02.00	S. No.	Property	Requirement		
	3.	Continuous operation suitability	At 70 deg. C for all types of cables, while 205 Deg C for Type-C cables.		
	4.	Progressive automatic on-line sequential marking of length in meters	To be provided at every one meter on outer sheath.		
	5.	Marking to read 'FRLS'	To be provided at every 5 meters on outer sheath except for Type-C cable.		
	6.	Allowable Tolerance on overall diameter	+/- 2 mm (maximum) over the declared value in data sheet		
	7.	Variation in diameter	Not more than 1.0 mm throughout the length of cable.		
	8	Ovality at any cross-section	Not more than 1.0 mm		
	9	Others	a) Durable marking at intervals not exceeding 625 mm shall include manufacturer's name, insulation material, conductor's size, number of pairs, voltage rating, type of cable, year of manufacturer to be provided. b) Cables shall be suitable for laying in conduits, ducts, trenches, racks and underground-buried installation c) Repaired cables shall not be acceptable.		
	Specific Requirements				
	Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
A. Conductors					
Cross section area	0.5 sq. mm				
Conductor	ANSI type	ANSI type	High conductivity	ANSI type KX	
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
	material	KX	SX	Annealed bare copper	
	Colour code	Yellow-Red	Black-Red	As per VDE-815	Yellow-Red
	Conductor Grade	As per ANSI MC 96.1		Electrolytic	As per ANSI MC 96.1
	No & dia of strands	7x0.3 mm (nom)			
	No. of Pairs	2	2	4,8,12,16,24,48	2
	Max. conductor resistance per Km (in ohm) at 20 deg. C	As per ANSI MC 96.1		73.4 (loop)	As per ANSI MC 96.1
	Reference Standard	As per ANSI MC 96.1		VDE 0815	As per ANSI MC 96.1
	B. Insulation				
	Material	PVC type YI 3			Teflon (i.e. extruded FEP)
	Thickness in mm (Min/Nom/Max)	0.25/0.3/0.35			0.4/0.50
	Volume Resistivity (Min) in ohm-cm	1 x 10 ¹⁴ at 20 deg. C & 1x10 ¹¹ at 70 deg. C.			---
	Voltage Rating	225 V peak operating voltage			
	Reference Standard	VDE 0207 Part 4			VDE 0207 Part 6 & ASTM D 2116.
	Core diameter above insulation	Suitable for cage clamp connector			
	C. Pairing & Twisting				
	Max. lay of pairs (mm)	50			
	Single layer of Numbered binder	Yes			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	tape on each pair provided			
	Unit formation of four pairs with printing of no. of Unit provided	N.A.	Yes	N.A.
	Conductor /pair identification as per VDE0815	N.A.	To be provided (color coding attached).	N.A.
	D. Shielding			
	Type of shielding	Al-Mylar tape		
	Individual pair shielding	No	To be provided for F-type cable	No
	Minimum thickness of Individual pair shielding	No	28 micron	No
	Overall cable assembly shielding	To be provided		
	Minimum thickness of Overall cable assembly shielding	55 micron		
	Shielding coverage	100% with at least 20% overlap		
	Drain wire provided for individual shield	N.A.	Yes (for F-type) 7-strand 20 AWG (0.51 mm ²) annealed Tin coated copper	N.A.
	Drain wire provided for overall shield	Yes. 7-strand 20 AWG (0.51 mm ²) annealed Tin coated copper		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	E. FILLERS			
	Non-hygroscopic, flame retardant	To be provided		
	F. Outer Sheath			
	Material	Extruded PVC compound YM1 with FRLS properties		Teflon (i.e. extruded FRP)
	Minimum Thickness at any point	1.8 mm		0.4 mm
	Nominal Thickness at any point	>1.8 mm		0.5 mm
	Color	Blue		
	Resistant to water, fungus, termite & rodent attack	Required		
	Oxygen index as per ASTMD-2863	not less than 29%		N.A.
	Temperature index as per ASTMD-2863	not less than 250 deg.C		N.A.
	acid gas generation by weight as per IEC-60754-1	Maximum 20%		N.A.
	Smoke Density Rating as per ASTMD-2843	Maximum 60% (defined as the average area under the curve when the results of smoke density test plotted on a curve indicating light absorption vs. time as per ASTMD-2843)		N.A.
	Reference standard	VDE207 Part 5		VDE207 Part 6 & ASTM D2116
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	G. Electrical Parameters			
	MUTUAL CAPACITANCE BETWEEN CONDUCTORS AT 0.8 KHZ (MAX.)	200 nF/km	120 nF/km for F type 100 nF/km for G-type	200 nF/km
	INSULATION RESISTANCE(MIN.)	100 M Ohm/Km		
	CROSS TALK FIGURE (MIN.) AT 0.8 KHZ	60 dB	60 dB	N.A.
	CHARACTERISTIC IMPEDANCE (MAX) AT 1 KHZ	N.A.	320 ohm for F-type 340 ohm for G-type	N.A.
	ATTENUATION FIGURE AT 1 KHZ (MAX)	N.A.	1.2 db/km	N.A.
	H. Complete Cable			
	Complete Cable assembly	Shall pass Swedish Chimney test as per SEN-SS 4241475 class F3.		N.A.
	Flammability	Shall pass flammability as per IEEE-383 read in conjunction to this specification		N.A.
	I. Accessories			
	Cable accessories of flame retardant quality.	Yes. (Accessories such as harnessing components, markers, bedding, cable jointer, binding tape etc.)		
	J. Tests			
	Routine & Acceptance tests	Refer sub-section IIIE		
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2		IHC-07: INSTRUMENTATION AND POWER SUPPLY CABLE
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Type tests	Refer sub-section-CNI TYPE TEST		
	K Cable Drum			
	Type	Non-returnable wooden drum (wooden drum to be constructed from seasoned wood free from defects with wood preservative applied to the entire drum) or steel drum.		
	Outermost layer covered with waterproof paper	Yes		
	Painting	Entire surface to be painted		
	Length	1000 m \pm 5% for up to & including 12 pairs 500 m \pm 5% for above 12 pairs		
3.00.00	SPECIFICATION OF OPTICAL FIBER CABLES (OFC)			
3.01.00	Optic Fiber cable shall be 4/8/12 core, galvanised corrugated steel taped armoured, fully water blocked with dielectric central member for outdoor/indoor application so as to prevent any physical damage. The cable shall have multiple single-mode or multi mode fibers on as required basis so as to avoid the usage of any repeaters. The core and cladding diameter shall be 9 +/- 1 micrometer and 125 +/- 1 micrometer respectively. The outer sheath shall have Flame Retardant, UV resistant properties and are to be identified with the manufacturer's name, year of manufacturer, progressive automatic sequential on-line marking of length in meters at every meter on outer sheath.			
3.02.00	The cable core shall have suitable characteristics and strengthening for prevention of damage during pulling viz. Steel central member, Loose buffer tube design, 4 fibers per buffer tube (minimum), Interstices and buffer tubes duly filled with Thixotropic jelly etc. The cable shall be suitable for a maximum tensile force of 2000 N during installation, and once installed, a tensile force of 1000 N minimum. The compressive strength of cable shall be 3000 N minimum& crush resistance 4000 N minimum. The operating temperature shall be -20 deg. C to 70 deg.C			
3.03.00	All testing of the fiber optic cable being supplied shall be as per the relevant IEC, EIA and other international standards.			
3.04.00	Bidder to ensure that minimum 100% cores are kept as spares in all types of optical fibre cables.			
3.05.00	Cables shall be suitable for laying in conduits, ducts, trenches, racks and under ground buried installation.			
3.06.00	Spliced / Repaired cables are not acceptable.			
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2	HIC-07: INSTRUMENTATION AND POWER SUPPLY CABLE	PAGE 7 OF 16

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3.07.00	Penetration of water resistance and impact resistance shall be as per IEC standard.																																							
4.00.00	SPECIFICATION OF POWER SUPPLY CABLES Refer relevant subsections of this specification.																																							
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>Type Of Cable</th></tr><tr><th>FROM (A)</th><th>TO (B)</th><th>END A</th><th>END B</th><th></th></tr><tr><td>Valves/dampers drives (Integral Junction box)</td><td>Marshalling cubicle/ Marshalling cum termination Cubicle/local group JB</td><td>Plug in connector</td><td>Posts 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>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>Screwed, 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 cubicle/ Marshalling cum termination Cubicle/local group JB	Plug in connector	Posts mount cage clamp type.	G	Transmitters, Process Actuated switches mounted in LIE/LIR	Integral Junction box of LIE/LIR	Plug in connector	Cage clamp (Rail mount) type.	F,G	RTD heads	Local junction box	Plug in connector	Cage clamp (Rail mount) type.	F	Thermocouple	CJC Box (if applicable)	Plug in connector	Cage clamp (Rail mount) type.	A,B,C*	Other Field Mounted Instrument	Local JB/Group JB	Plug in connector	Screwed, Cage clamp (Rail mount) type	F,G
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	RTD	Temperature transmitter	Plug in connector	Screwed, Cage clamp type	F
	Thermocouple	Temperature transmitter	Plug in connector	Screwed, Cage clamp type	A,B,C*
	Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/Group JB/ MCC/SWGR	Group JB	Cage clamp (Rail mount) type.	Cage clamp (Rail mount) type.	F,G
	Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/Group JB/ MCC/SWGR	Marshalling Cubicle/ Marshalling Termination Cabinet cum	Cage clamp (Rail mount) type.	Posts cage mount type.	F,G
	Marshalling cubicle/ Termination Cabinet	Electronic system cabinet	Cage clamp Post mounted type.	Plug in connector/Other System as per manufacturer's Standard	Internal wiring
	Marshalling/ Termination System Cabinets	UCD mounted equipments	Post mount cage clamp type.	Plug in connector/Cage clamp type (rail mounted).	F,G (with plug-in connector at one end)
	DDCMIS/PLC cabinets	PC, Printers etc.	Plug in connector	Plug in connector	Mfr.'s Standard
Notes <ol style="list-style-type: none"> 1. Normally 10% spare cores shall be provided when the numbers of pairs of cables are more than four pairs. 2. For analog signals, individual pair shielding & overall shielding & for Binary signals, only overall shielding of instrumentation cables shall be provided. 					
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2		110-97: INSTRUMENTATION AND POWER SUPPLY CABLE	PAGE 9 OF 16

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	<div>3. Also refer Drg. 4610-110-POI-A-021.</div> <div>4. *For high temperature applications only.</div> <div>5. Instrument Cabling for instruments/equipments covered under subsection MAIN EQP INST SYS shall be as per manufacturer's standard .</div>			
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 terminal blocks for DDCMIS input/output connections from/to SWGR/MCC, Actuators with Integral Starter (for coupling relays and check back signals of 11 kV and 3.3 kV auxiliaries, LT drives/valves & dampers/solenoids, CT & VT, etc.) shall be provided with built in test and disconnect facilities complete with plug, slide clamp, test socket etc. The exact type of terminal blocks to be provided by the Bidder and the technical details of the same including width etc. shall be subject to Employer's approval.			
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, test plug bolts and test plug (as specified above for SWGR connections) 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.			
6.06.00	For ensuring proper connections, Bidder shall provide suitable accessories, along with insulation sleeves. The exact connecting accessory shall be finalised as per application during detail engineering stage subject to Employer's approval without any cost repercussions.			
6.07.00	Internal wiring in factory pre-wired electronic equipment cabinets may be installed according to the Bidder's standard as to wire size and method of termination or internal equipment. Terminal blocks for connection of external circuits into factory			
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2	THE : INSTRUMENTATION AND POWER SUPPLY CABLE	PAGE 10 OF 16

CLAUSE NO.	TECHNICAL REQUIREMENTS						
	prewired electronic equipment cabinets shall meet all the requirements as specified above.						
7.00.00	INTERNAL PANELS/ SYSTEM CABINETS WIRING						
7.01.00	Internal panel/cabinet wiring shall be of multi-stranded copper conductor with FRLS PVC insulation without shield and outer sheath meeting the requirements of VDE 0815.						
7.02.00	Wiring to door mounted devices shall be done by 19 strand copper wire provided with adequate loop lengths of hinge wire so that multiple door opening shall not cause fatigue breaking of the conductor.						
7.03.00	All internal wires shall be provided with tag and identification nos. etched on tightly fitted ferules at both ends in Employer's approved format. All wires directly connected to trip devices shall be distinguished by one additional red colour ferrule.						
7.04.00	All external connection shall be made with one wire per termination point. Wires shall not be tapped or spliced between terminal points.						
7.05.00	All floor slots of desk/panels/cabinets used for cable entrance shall be provided with removable gasketed gland plates and sealing material. Split type grommets shall be used for prefabricated cables.						
7.06.00	All the special tools as may be required for solder less connections shall be provided by Bidder.						
7.07.00	Wire sizes to be utilised for internal wiring. (i) Current (4-20 mA), low voltage signals (48V); Ammeter/Voltmeter circuit, control switches etc. for electrical system. 0.5 Sq.mm. (ii) Power supply and internal illumination. 2.5Sq.mm. minimum (shall be as per load requirement.)						
8.00.00	INSTRUMENTATION CABLE INSTALLATION AND ROUTING						
8.01.00	All cables assigned to a particular duct/conduit shall be grouped and pulled in simultaneously using cable grips and suitable lubricants. Cables removed from one duct/conduit shall not be reused without approval of Employer.						
8.02.00	Cables shall be segregated as per IEEE Std.-422. In vertically stacked trays, the higher voltage cable shall be in higher position and instrumentation cable shall be in bottom tier of the tray stack. The distance between instrumentation cables and those of other system shall be as follows:						
<table><tr><td>NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE</td><td>TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2</td><td>110207 INSTRUMENTATION AND POWER SUPPLY CABLE</td><td>PAGE 11 OF 16</td></tr></table>				NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2	110207 INSTRUMENTATION AND POWER SUPPLY CABLE	PAGE 11 OF 16
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CLAUSE NO.	TECHNICAL REQUIREMENTS
<p>8.03.00</p> <p>8.04.00</p> <p>8.05.00</p> <p>8.06.00</p>	<p>From 11 kV/6.6 kV/3.3 kV tray system - 914 mm</p> <p>From 415V tray system - 610 mm</p> <p>From control cable tray system - 305 mm</p> <p>Cables shall terminate in the enclosure through cable glands. All cable glands shall be properly gasketed. Fire proof sealing (to prevent ingress of dust entry and propagation of fire) shall be provided for all floor slots used for cable entrance. Compression cable glands (double for armoured and single for other cables) shall be provided.</p> <p>All cables shall be identified by tag. Nos. provided in Employer's approved format at both the ends as well as at an interval of 5 meters.</p> <p>Line voltage drop due to high resistance splices, terminal contacts, insulation resistance at terminal block, very long transmission line etc. shall be reduced as far as practicable.</p> <p>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.</p>
9.00.00	CABLE LAYING AND ACCESSORIES
9.01.00	<p>CABLE LAYING</p> <p>1 CABLES SHALL BE LAID STRICTLY IN LINE WITH CABLE SCHEDULE.</p> <p>2 IDENTIFICATION TAGS FOR CABLES.</p> <p>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.</p> <p>3 CABLE TRAY NUMBERING AND MARKING.</p> <p>TO BE PROVIDED AT EVERY 10M AND AT EACH END OF CABLE WAY & BRANCH CONNECTION.</p> <p>4 JOINTS FOR LESS THAN 250 METERS RUN OF CABLE SHALL NOT BE PERMITTED.</p> <p>5 BURIED CABLE PROTECTION</p> <p>WITH CONCRETE SLABS; ROUTE MARKERS AT EVERY 20 METERS ALONG THE ROUTE & AT EVERY BEND.</p>
<p>NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE</p>	<p>TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2</p> <p>110-27 INSTRUMENTATION AND POWER SUPPLY CABLE</p> <p>PAGE 12 OF 16</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS				
9.02.00	<p>6 ROAD CROSSINGS</p> <p>CABLES TO PASS THROUGH BURIED HIGH DENSITY PE PIPES ENCASED IN PCC. AT LEAST 300 MM CLEARANCE SHALL BE PROVIDED BETWEEN</p> <ul style="list-style-type: none">- HT POWER & LT POWER CABLES,- LT POWER & LT CONTROL CABLES- LT CONTROL & INSTRUMENTATION CABLES, <p>SPACING BETWEEN CABLES OF SAME VOLTAGE GRADE SHALL BE IN ACCORDANCE WITH THE DERATING CRITERIA ADOPTED FOR CABLE SIZING.</p> <p>7 SEGREGATION (PHYSICAL ISOLATION TO PREVENT FIRE JUMPING)</p> <p>A ALL CABLE ASSOCIATED WITH THE UNIT SHALL BE SEGREGATED FROM CABLES OF OTHER UNITS.</p> <p>B INTERPLANT CABLES OF STATION AUXILIARIES AND UNIT CRITICAL DRIVES SHALL BE SEGREGATED IN SUCH A WAY THAT NOT MORE THAN HALF OF THE DRIVES ARE LOST IN CASE OF SINGLE INCIDENT OF FIRE.</p> <p>8 CABLE CLAMPING</p> <p>ALL CABLES LAID ON TRAYS SHALL BE NEATLY DRESSED UP & SUITABLY CLAMPED/TIED TO THE TRAY. FOR CABLES IN TREFOIL FORMATION, TREFOIL CLAMPS SHALL BE PROVIDED.</p> <p>9 Optical fiber cables inside conduit shall be laid on cable trays wherever available and feasible. In areas where the same are required to be buried, the same shall be buried in separate trench approx.1.6 meter depth, to be laid in 2" GI/rodent proof HDPE conduits covered with sand, brick and soil along the pipe line route;</p> <p>While crossing roads - to be laid in GI/rodent proof HDPE conduits with sand filling at bottom and sand, soil filling at top with cement concrete;</p> <p>While crossing canals/river- to be laid in GI/rodent proof HDPE conduits within hume pipe.</p>				
	<p>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.</p>				
<table><tr><td>NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE</td><td>TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2</td><td>110-2 INSTRUMENTATION AND POWER SUPPLY CABLE</td><td>PAGE 13 OF 16</td></tr></table>		NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2	110-2 INSTRUMENTATION AND POWER SUPPLY CABLE	PAGE 13 OF 16
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9.03.00	Bidder shall furnish two completely new sets of cable termination kits like Crimping tools, etc., which are required for maintenance of the system as per the type of termination used.
9.04.00	Cables, which terminate in cabinets of draw out sections shall have sufficient cable coiled in the bottom of the cabinet to permit full withdrawal of draw out sections without disconnecting the cables. When prefabricated cables with factory connectors on both ends are longer than required, the excess cable shall be coiled in the bottom of one or both termination cabinets.
9.05.00	No splices shall be made in conductors for instrument and control circuits except where required at connections to devices equipped with factory installed pigtails. Such splices shall be made only in approved splicing boxes of fitting with removable cover. The splices shall be made with sufficient slack left in the wires to permit withdrawal of the splice from the splicing box for ease of future disconnection of the splices. All exposed conductor or connector surfaces shall be covered with a minimum of three half-lapped layers of all weather vinyl plastic electrical tape. Taping shall extend a minimum of two cable diameters over the cable jacket and a similar distance over the other insulation or connections requiring insulation.
9.06.00	The Bidder shall be responsible for proper grounding of all equipment under C&I package. Further, proper termination of cable shields shall be verified and the grounding of the same shall be coordinated so as to achieve grounding of all instrumentation cable shields at same potential. This shall be completed prior to system tests. All the cables etc. required for grounding of all equipments supplied under this package are to be supplied by the Bidder.
9.07.00	The Contractor shall take full care while laying / installing cables as recommended by cable manufacturers regarding pulling tensions and cable bends. Cables damaged in any way during installation shall be replaced at the expense of the Contractor.
10.00.00	<p>FIELD MOUNTED LOCAL JUNCTION BOXES</p> <p>(i) No. of ways 12/24/36/48/64/72/96/128 with 20% spares terminals.</p> <p>(ii) Material and Thickness 4mm thick Fiberglass Reinforced Polyester (FRP).</p> <p>(iii) Type Door gasket shall be of synthetic rubber.</p> <p>(iv) Mounting clamps and accessories Suitable for mounting on walls, columns, structures etc. The brackets, bolts, nuts, screws, glands and lugs required for erection shall be of brass, included in Bidders scope of supply. Raceways shall be provided inside JB's for proper termination of cables.</p> <p>(v) Type of terminal blocks Rail mounted cage-clamp type suitable for conductor size upto 2.5 mm². A M6 earthing stud shall be provided.</p>
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(vi) Protection Class	IP: 55 minimum for indoor & IP-65 minimum for outdoor applications.		
	(vii) Grounding	To be provided.		
	(viii) Color	To be decided during detailed engineering & subject to Employer's approval.		
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 steel, water leak, fire and rust proof. The temperature rating of flexible conduit shall be suitable for actual application.			
11.02.00	The Bidder shall install conduits according to the general routing as approved by Employer and shall coordinate conduit locations with other works.			
11.03.00	All grounding bushings within all enclosures shall be wired together and connected internally to the enclosure grounding lug or grounding bus with 8 AWG bare copper conductor. Conduit runs to individually mounted equipment shall be grounded to the Employer's cable tray grounding conductor with 12 AEG bare copper conductor. All grounding bushings, clamps and connectors shall be subject to approval of the Employer.			
11.04.00	All rigid conduit fittings shall conform to the requirements of IS: 2667, 1976. Galvanized steel fitting shall be used with steel conduit. All flexible conduit fittings shall be liquid tight, galvanized steel. The end fittings shall be compatible with the flexible conduit supplied.			
11.05.00	All individually mounted equipment and devices shall be connected to the supply conduit, using not more than one meter of flexible conduit adjacent to the equipment or device. Flexible conduit shall be installed in all conduit runs, which are supported by both building steel and structures subject to vibration or thermal expansion. This shall include locations where conduit supported by building steel enters or becomes supported by the turbine generator foundation and where conduit supported by building steel or foundation becomes supported by steam generator framing.			
11.06.00	Special areas, such as control rooms in which external noise is to be minimized, shall have flexible conduit in conduit runs where the runs cross from the main building framing to the control room framing.			
11.07.00	Conduit supports shall be furnished and installed in accordance with these specifications. Support material shall comply with the following requirements. i) Hanger rods shall be 12 mm diameter galvanized threaded steel rods. ii) Single conduit supports shall be one-hole cast metal straps and clamp backs			
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	<p>unless other types are acceptable to the Employer. Multiple conduit bank supports shall be constructed of special galvanized support channels with associated conduit clips.</p>
11.08.00	<p>Conduit sealing, explosion proof, dust proof and other types of special fittings shall be provided as required by these specifications and shall be consistent with the area and equipment with which they are installed. Fittings installed outdoors and in damp locations shall be sealed and gasketed. Hazardous area fittings and conduits sealing shall conform to NEC requirements for the area classification.</p>
11.09.00	<p>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.</p>
11.10.00	<p>Conduits shall be securely fastened to all boxes and cabinets.</p>
12.00.00	<p>CABLE SUB-TRAY & SUPPORT</p>
12.01.00	<p>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).</p>
12.02.00	<p>The covers on the cable sub-trays shall be used for protection of cables in areas where damage may occur from falling objects, welding spark, corrosive environment, etc. & shall be electrically continuous and solidly grounded. The cable trays shall not have sharp edges, burrs or projections injurious to the insulation or outer sheath of the cables.</p>
12.03.00	<p>The supporting arrangement of cable tray system shall be able to withstand the weight of the cable and cable tray system. The supporting interval shall not be more than the recommended span for the above loading for the type of cable tray selected. The tray shall not overhang by more than one meter from the support at the dead end. As far as practicable the cable sub-tray system shall be supported from one side only, in order to facilitate installation and maintenance of cables.</p>
12.04.00	<p>The Bidder shall furnish and install the estimated quantities and sizes of sub trays/troughs including all required fittings and adaptors on as required basis.</p>
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CLAUSE NO.	TECHNICAL REQUIREMENTS
	<div>TYPE TEST REQUIREMENTS</div> <div>1.00.00TYPE TEST REQUIREMENTS</div> <div>1.01.00General Requirements</div> <div>1.01.01<p>The Contractor shall furnish the type test reports of all type tests as per relevant standards and codes as well as other specific tests indicated in this specification. A list of such tests are given for various equipment in table titled 'TYPE TEST REQUIREMENT FOR C&I SYSTEMS' at the end of this chapter and under the item Special Requirement for Solid State Equipments/Systems. For the balance equipment instrument, type tests may be conducted as per manufactures standard or if required by relevant standard.</p><p>(a) Out of the tests listed, the Bidder/ sub-vendor/ manufacturer is required to conduct certain type tests specifically for this contract (and witnessed by Employer or his authorized representative) even if the same had been conducted earlier, as clearly indicated subsequently against such tests.</p><p>(b) For the rest, submission of type test results and certificate shall be acceptable provided.</p><p>i. The same has been carried out by the Bidder/ sub-vendor on exactly the same model /rating of equipment.</p><p>ii. There has been no change in the components from the offered equipment & tested equipment.</p><p>iii. The test has been carried out as per the latest standards alongwith amendments as on the date of Bid opening.</p><p>(c) In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the Bidder/ sub-vendor within the quoted price and no extra cost will be payable by the Employer on this account.</p></div> <div>1.01.02<p>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.</p></div> <div>1.01.03<p>The schedule of conduction of type tests/ submission of reports shall be submitted and finalized during pre-award discussion.</p></div> <div>1.01.04<p>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.</p></div>
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CLAUSE NO.	TECHNICAL REQUIREMENTS
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.
2.00.00	SPECIAL REQUIREMENT FOR SOLID STATE EQUIPMENTS/ SYSTEMS
2.01.00	<p>The minimum type test reports, over and above the requirements of above clause, which are to be submitted for each of the major C&I systems shall be as indicated below:</p> <p>i) Surge Withstand Capability (SWC) for Solid State Equipments/ Systems</p> <p>All solid state systems/ equipments shall be able to withstand the electrical noise and surges as encountered in actual service conditions and inherent in a power plant. All the solid state systems/ equipments shall be provided with all required protections that needs the surge withstand capability as defined in ANSI 37.90.1/ IEEE-472. Hence, all front end cards which receive external signals like Analog input & output modules, Binary input & output modules etc. including power supply, data highway, data links shall be provided with protections that meets the surge withstand capability as defined in ANSI 37.90.1/ IEEE-472. Complete details of the features incorporated in electronics systems to meet this requirement, the relevant tests carried out, the test certificates etc. shall be submitted along with the proposal. As an alternative to above, suitable class of EN 61000-4-12 which is equivalent to ANSI 37.90.1/ IEEE-472 may also be adopted for SWC test.</p> <p>ii) Dry Heat test as per IEC-68-2-2 or equivalent.</p> <p>iii) Damp Heat test as per IEC-68-2-3 or equivalent.</p> <p>iv) Vibration test as per IEC-68-2-6 or equivalent.</p> <p>v) Electrostatic discharge tests as per EN 61000-4-2 or equivalent.</p> <p>vi) Radio frequency immunity test as per EN 61000-4-6 or equivalent.</p> <p>vii) Electromagnetic Field immunity as per EN 61000-4-3 or equivalent.</p> <p>Test listed at item no. v, vi, vii, above are applicable for electronic cards only as defined under item (i) above.</p>
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE	<div> <div> TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2 </div> <div> <div>TYPE TEST REQUIREMENTS</div> <div>PAGE 2 OF 9</div> </div> </div>

CLAUSE NO.	TECHNICAL REQUIREMENTS					
3.00.00	TYPE TEST REQUIREMENT FOR C&I SYSTEMS					
	Sl. No	Item	Test Requirement	Standard	Test To Be Specifically Conducted	NTPC's Approval Req. On Test Certificate
	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6
	1	Elect. Metering instruments	As per standard (col 4)	IS-1248	No	Yes
	2	Thermocouple	Degree of protection test	IS-2147	No	No
	3	CJC Box	Degree of protection test	IS-2147	No	No
	4	RTD	As per standard (col 4)	IEC-60751	No	No
	5	Electronic transmitter	As per standard (col 4)	BS-6447 / IEC-60770	No	Yes
	6	E/P converter	As per standard (col 4)	Mfr. standard	No	Yes
	7	Instrumentation Cables Twisted & Shielded				
		-Conductor	Resistance test	VDE-0815	Yes	Yes
			Diameter test	IS-10810	Yes	Yes
			Tin Coating test (Persulphate test)	IS-8130	Yes	Yes
		-Insulation	Loss of mass	VDE 0472	Yes	Yes
			Ageing in air ovens**	VDE 0472	Yes	Yes
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE			TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2		REMARKS: TYPE TEST REQUIREMENTS	PAGE 3 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS				
		Tensile strength and elongation test before and after ageing**	VDE 0472	Yes	Yes
		Heat shock	VDE 0472	Yes	Yes
		Hot deformation	VDE 0472	Yes	Yes
		Shrinkage	VDE 0472	Yes	Yes
		Bleeding & blooming	IS-10810	Yes	Yes
	-Inner sheath***	Loss of mass	VDE 0472	Yes	Yes
		Heat shock	VDE 0472	Yes	Yes
		Cold bend/ cold impact test	VDE 0472	Yes	Yes
		Hot deformation	VDE 0472	Yes	Yes
		Shrinkage	VDE 0472	Yes	Yes
	-Outer sheath	Loss of mass	VDE 0472	Yes	Yes
		Ageing in air ovens**	VDE 0472	Yes	Yes
		Tensile strength and elongation test before and after ageing**	VDE 0472	Yes	Yes
		Heat shock	VDE 0472	Yes	Yes
		Hot deformation	VDE 0472	Yes	Yes
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2		TYPE TYPE TEST REQUIREMENTS	
				PAGE 4 OF 9	


CLAUSE NO.	TECHNICAL REQUIREMENTS				
	<div>Shrinkage VDE 0472 Yes Yes</div> <div>Bleeding & blooming IS-10810 Yes Yes</div> <div>Colour fastness to water IS-5831 Yes Yes</div> <div>Cold bend/ cold impact test VDE-0472 Yes Yes</div> <div>Oxygen index test ASTMD-2863 Yes Yes</div> <div>Smoke Density Test ASTMD-2843 Yes Yes</div> <div>Acid gas generation test IEC-60754-1 Yes Yes</div> <div>-fillers Oxygen index test ASTMD-2863 Yes Yes</div> <div>Acid gas generation test IEC-60754-1 Yes Yes</div> <div>-AL-MYLAR shield Continuity test Yes Yes</div> <div>Shield thickness Yes Yes</div> <div>Overlap test Yes Yes</div> <div>-Over all cable Flammability Test IEEE 383 Yes Yes</div> <div>Swedish Chimney Test SEN 4241475 Yes Yes</div> <div>Noise interference IEEE Trans-actions Yes Yes</div>				
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2		TYPE TEST REQUIREMENTS	PAGE 5 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Dimensional checks	IS 10810	Yes	Yes
	Cross talk	VDE-0472	Yes	Yes
	Mutual capacitance	VDE-0472	Yes	Yes
	HV test	VDE-0815	Yes	Yes
	Drain wire continuity		Yes	Yes
	* For Drain wire only			
	**These tests shall be carried out as per VDE0207 Part 6 & ASTM D-2116 for TEFLON insulated & outer sheathed cables			
	***Applicable for armoured cables only			
8	DC Power Supply System (Applicable for each model and rating)			
	Degree of protection test	IS-13947	Yes	Yes
	Short circuit current capability	Approved procedure	Yes	Yes
	Voltage Proof Test	UL 950, IEC950	Yes	Yes
	Burn In test	Approved procedure	Yes	Yes
	Efficiency	Approved procedure	Yes	Yes
	Audible Noise Test	Approved procedure	Yes	Yes
	Fuse Clearing Capability	Approved procedure	Yes	Yes
	Total harmonic content	Approved procedure /CIGRE's	Yes	Yes
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2		TYPE TEST REQUIREMENTS PAGE 6 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS				
	Radio Frequency interference	IEC-CISPR22, IEC-61000-4-12(9b), IEC-61000-4-3, IEC-61000-4-5, IEC-61000-4-6	Yes	Yes	
	Over Load Test	Approved procedure	Yes	Yes	
	Restart Test	Approved procedure	Yes	Yes	
	Output voltage tolerance	Approved procedure	Yes	Yes	
	Parallel operation	Approved procedure	Yes	Yes	
	ESD immunity Test	IEC-61000-4-2-9(1)	Yes	Yes	
	Electrical Fast transient/Burst Immunity Test	IEC-61000-4-4	Yes	Yes	
	Surge Protection	IEC61312, IEC61024, VDE 100-534	Yes	Yes	
	Insulation Test	Approved procedure	Yes	Yes	
	Load Tests.	Approved procedure	Yes	Yes	
	Preliminary light load test (without	Approved procedure	Yes	Yes	
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2	TYPE TYPE TEST REQUIREMENTS	PAGE 7 OF 9		

CLAUSE NO.	TECHNICAL REQUIREMENTS					
	<p>Battery supply)</p> <p>Load sharing Approved procedure Yes Yes</p> <p>9 Battery As per standard (col 4) IS-10918 No Yes Note-2</p> <p>10 Voltage Stabiliser Over Load Test Approved procedure No Yes</p> <p>Temp rise test without redundant fans Approved procedure No Yes</p> <p>Input voltage variation test Approved procedure No Yes</p> <p>11 DDCMIS</p> <p>CLCS Systems Model test Approved procedure Yes Yes</p> <p>BMS Safety requirements VDE0116 Sec 8.7 No Yes</p> <p>12 Conductivity Type Level Switch Degree of protection test IS-2147 No No</p> <p>13 Local Gauges Degree of protection test IS-2147 No No</p> <p>14 Process actuated Switches Degree of protection test IS-2147 No No</p> <p>15 Control Valves CV test ISA 75.02 Yes Yes</p> <p>16 PLCs As per standard (Col 4) IEC 1131 No No</p>					
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2		NOTE: TYPE TEST REQUIREMENTS	PAGE 8 OF 9	

CLAUSE NO.	TECHNICAL REQUIREMENTS					
	17	LIE / LIR	Degree of protection test	of IS-2147	Yes	Yes
	18	Flue gas O2 analyser, other Flue Gas analysers	Degree of protection test	of IS-2147	No	Yes
	19	Flow Nozzles & Orifice plates	Calibration	ASME PTC BS 1042	Yes	Yes
	<p>Note:</p> <p>1. Type Tests are to be conducted only for the items, which are being supplied as a part of this Package.</p> <p>2. a) For batteries supplied with electric power supply system of DDCMIS Systems the contractor shall submit for Owner's approval the reports of all the type test as per IS 10918 carried out within last five (5) years from the date of bid opening and the tests should have been either conducted at an independent laboratory or should have been witnessed by a client. The complete type test reports shall be for any rating of battery in a ;particular group, based on plate dimensions being manufactured by supplier.</p> <p>b) For electric power supply system of auxiliary plants, not controlled from DDCMIS systems type test report for batteries shall be as per supplier's standard practice.</p>					
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO.: CS-0270-110-2			TYPE TEST TYPE TEST REQUIREMENTS	
					PAGE 9 OF 9	

	TITLE: TECHNICAL SPECIFICATION FOR HYDROGEN GENERATION PLANT 4X250 MW, NABINAGAR THERMAL POWER PLANT	SPEC. NO. PE-TS-300-168-A000	
		VOLUME II-B	
		SECTION	
		REV. NO. 0	DATE:
		SHEET	OF

SECTION – D4 QUALITY PLANS

CLAUSE NO.	QUALITY ASSURANCE									
MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)										
MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)										
TESTS ITEMS										
		Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Test as per standard(R)	Insulation Resistance (R)	IBR Certification (if applicable)(R)	Hydro Test (R)	Material Test certificate ®
1. PR Gauge (IS-3624)		Y	Y	Y	Y	Y				
2. Temp. Gauge (BS-5235)		Y	Y	Y	Y	Y				
3. Pr./D.P.Switch (BS-6134)		Y	Y	Y	Y	Y	Y			
4. Electronic Transmitter (IEC-770)		Y	Y	Y	Y	Y	Y			
5. Temp. Switch		Y	Y	Y	Y	Y	Y			
6. Recorder (IS-9319/ANSI C-39.4)		Y	Y	Y	Y	Y	Y			
7. Vertical indicators		Y	Y	Y	Y		Y			
8. Digital Indicators		Y	Y	Y	Y		Y			
9. Integrators		Y	Y	Y	Y					
10. Electrical Metering Instrument (IS-1248)		Y	Y	Y	Y	Y	Y			
11. Transducer (IEC-688)		Y	Y	Y	Y	Y	Y			
12. Thermocouples (ANSI-MC-96.1)		Y	Y	Y	Y	Y	Y			
13. RTD(IEC-751)		Y	Y	Y	Y	Y	Y			
14. Thermowell		Y		Y				Y	Y	Y
R-Routine Test A- Acceptance Test Y – Test applicable										
Note: 1) Detailed procedure of Burn-in and Elevated Temperature 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.										

NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2	MEASURING INSTRUMENTS (P&S)	PAGE 1 OF 2
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CLAUSE NO.		QUALITY ASSURANCE											
ITEMS	TESTS	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Requirement as per standard (R)	WPS approval (A)	Non-destructive testing (R)	Calculation for accuracy (R)	Insulation Resistance (R)	IBR Certification as applicable (R)	Hydro test (R)	Material test certificate (A)
15. Cold junction compensation box		Y	Y	Y	Y					Y			
16. Orifice plate(BS-1042)		Y	Y	Y	Y*	Y	Y*	Y*			Y	Y*	Y
17. Flow nozzle(BS-1042)		Y	Y	Y	Y*	Y	Y	Y			Y	Y	Y
18. Impact head type element		Y	Y	Y					Y				Y
19. Level transmitter/float type switch		Y	Y	Y	Y					Y	Y	Y	Y
20. Flue Gas analyser		Y	Y	Y	Y								
21. Dust emission monitors		Y	Y	Y	Y								
*Calibration to be carried out on one flow element of each type and size if calibration carried out as type test same shall not be repeated.													
** If applicable													
R-Routine Test A- Acceptance Test Y – Test applicable													
Note: 1) Detailed procedure of Burn-in and Elevated Temperature 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.													

NABINAGAR THERMAL POWER PROJECT STAGE-1 (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2	MEASURING INSTRUMENTS (P&S)	PAGE 2 OF 2
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INSTRUMENTATION CABLES.

INSTRUMENTATION CABLE													
ITEMS	TESTS												
	Visual, Surface finish (A)	Constructional detail, dimensions (A)	Outer-Sheath/core marking, end	FRLS Test * (A)	Insulation Resistance (A)	High Voltage ®	Spark Test Report Review ®	Volume Resistivity (A)	Conductor Resistance ®	Electrical Parameters ** (A)	Tensile Elongation before & after	Thermal Stability (A)	Overall/Coverage/Continuity (A)
1. Instrument cable twisted and shielded													
Conductor(IS-8130)	Y	Y							Y				
Insulation(VDE-207)	Y	Y	Y				Y				Y	Y	
Pairing/Twisting	Y	Y	Y										
Shielding	Y	Y											Y
Drain wire	Y	Y							Y				Y
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

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 : R- Routine Test A - Acceptance Test Y - Test 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)

*** Flammability Test : Vertical Flame Test (IEEE-383) , Swedish Chimney (SS-4241475)

CLAUSE NO.

QUALITY ASSURANCE

PLC BASED CONTROL AND INSTRUMENTATION
FOR PLANT AUXILIARY SYSTEMS
PROGRAMMABLE LOGIC CONTRLLER


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/ Mosaic Items/ Transducers ®	Accessibility of TBS/ Devices ®	Illumination ®	Functional Check for Control Element , Annunciation ®	Mimic ®	Test as per IEC 1131 ® *
1. PLC Panel	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 Burn-in and Elevated Temperature 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

CLAUSE NO.		QUALITY ASSURANCE												
ELECTRIC POWER SUPPLY SYSTEM														
Attributes / Characteristics		Make, Model, Type, Rating & Finish	Chemical & Mechanical Tests	Sheet Steel Pretreatment & Painting process checks	Conform to relevant Standard	Dimensional check and Paint shade, thickness, adhesion & Finish checks	Complete physical examination for constructional features of Battery Charger as per NTPC specification	Temperature Rise Test	Dynamic Response Test	Ripple Content Test, Load Limiter & Annunciator & AVR Operation Test	Operational & Functional Checks	HV & IR Test	Burn-In Test at 50°C for 48 hrs	Degree of Protection Test as per NTPC
Items / Components / Sub- assembly														
BATTERY CHARGER														
Rectifier Transformer (IS : 2026)	Y				Y			Y				Y		
Electronic Components including Potentiometer (Vernier Type)	Y				Y									
PCB & Electronic Cards	Y				Y									
19" standard racks for electronic cards	Y						Y							
Control & Selector Switches (IS : 6875)	Y				Y						Y			
Indicating Meters (IS : 1248)	Y				Y						Y			
Indicating Lamps (IS: 13947)	Y				Y						Y			
Air Break Switches / Fuses (IS : 13947 / 13703)	Y				Y						Y			
Control Terminal Blocks (IS :13947)	Y				Y									
Control Transformer (IS : 1202)	Y				Y						Y			
Push Buttons (IS : 4794)	Y				Y						Y			
MCB (IS : 8828)	Y				Y						Y			
PVC insulated Copper control wires (IS : 694)	Y				Y									
Sheet Steel (IS : 513)	Y	Y	Y		Y									
Synthetic Rubber Gaskets	Y	Y			Y									
Annunciator	Y										Y		Y	
Battery Charger	Y					Y	Y	Y	Y	Y		Y	Y	Y
Notes:1.Detailed procedure of Burn-in and Elevated Temperature 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 Practice and procedure along with relevant supporting documents. 3. Makes of all major Bought Out Items will be subject to NTPC approval.														
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2					 ELECTRIC POWER SUPPLY SYSTEM					PAGE 1 OF 2		

POWER SUPPLY SYSTEM																		
ITEMS	TESTS	Visual/dimension/rating/ Paint Adhesion/ Thickness (R)	General arrangement/BOM/make of components /Mimic ®	Efficiency ,regulation(R)	Input voltage variation (A)	Out put voltage and frequency adj.range(A)	Premilinary light load test(R)	Load transfer retransfer test (R) *	AC input failiure and return test (R)	Parralel operation and current divison(R)	Relative harmonic content(R)	Restart with PRI A.C and battery (separately)(R)	System transfer and retransfer (R)*	Asynchronous transfer(R)	Ripple content(R)	Load limiter operation (R)	IR/HV(R)	Tests as per standard &specification (R)&(A)
UPS/CONVERTER (IEC-146 PT-4)		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
VOLTAGE STABILISER		Y	Y	Y	Y	Y					Y		Y				Y	
LEAD ACID BATTERY(TUBLAR)-IS-1651																		Y
LEAD ACID BATTERY (PLANTE)-IS-1652																		Y
NICKEL CADMIUM BATTERY(IS-10918/IEC-623)																		Y
R-Routine Test		A- Acceptance Test							Y – Test applicable									
* Transfer time and Over shoot /under shoot during load & system transfer shall be recorded .																		
Note: 1) Detailed procedure of Burn-in and Elevated Temperature test shall be as per Quality Assurance Programme in General Technical Conditions																		
2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.																		

CLAUSE NO.	QUALITY ASSURANCE												
HYDROGEN GENERATION PLANT													
HYDROGEN GENERATION PLANT-TESTS													
Tests/Check Items / Components	Material Test	WPS/PQR/Welder	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.													

NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B BID DOC. NO. : CS-0270-110-2	 HYDROGEN GENERATION PLANT	PAGE 1 OF 1
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	TITLE: TECHNICAL SPECIFICATION FOR HYDROGEN GENERATION PLANT 4X250 MW, NABINAGAR THERMAL POWER PLANT	SPEC. NO. PE-TS-300-168-A000	
		VOLUME II-B	
		SECTION	
		REV. NO. 0	DATE:
		SHEET	OF

SECTION – D5


DATA SHEET – A, B AND C

PROJECT : NABINAGAR TPS (X250 MW)


DATA SHEET A

SPECIFIC ELECTRICAL REQUIREMENT

SL.NO.	MOTOR	UNIT	TECHNICAL PARAMETERS
1	DESIGN AMBIENT TEMP	DEG. C	50
2	VOLTAGE SUPPLY AND VARIATION	VOLT	415±10%
3	FREQUENCY WITH VARIATION	Hz	50+ 3% & - 5%
4	COMBINED VOLTAGE & FREQUENCY VARIATION		+/-10%
5	MAX ACCEPTABLE RATING OF MOTOR AT 415 V	KW	200
6	SYSTEM FAULT LEVEL AND ITS DUARTION	KA	45kA, 1sec
7	SUITABILITY OF TERMINAL BOX FOR FAULT LEVEL AND DURATION		45 KA, 0.25 SEC
8	CLASS OF INSULATION & TEMP RISE LIMITED TO		Class B or Better
9	MIN. STARTING VOLTAGE		85%
10	MOTOR RATING FOR SINGLE PHASE SUPPLY		200W & Below
11	MAXIMUM LOCKED ROTOR CURRENT (EXCLUDING IS TOLERANCE)	% OF FLC	600%
12	ACCEPTABLE NOISE LEVEL	DB	85dB at 1.5m
13	TYPE OF STARTER PROVIDED IN MCC		DOL
14	DOP OF ENCLOSURE		IP-54 for Indoor & IPW-55 for outdoor
15	SPACE HEATER REQUIREMENT	<30kW	Above 30kW
16	PAINT SHADE		RAL 5012 (Blue)

Clause No.	BIDDER'S NAME.....	
	HYDROGEN GENERATION PLANT	
1.00.00	TYPE OF PLANT	Unit Polar / Bipolar Type
1.01.00	GENERAL	
1.02.00	Manufacturer	
1.03.00	Guaranteed performance data	
1.03.01	Hydrogen generation Plant Capacity (NM ³ /hr)	.....
1.03.02	No. of Streams	.....
1.03.03	Capacity of each Stream	.....
1.03.04	Hydrogen Purity (%)	.....
1.03.05	Moisture content	.....
1.03.06	Whether the Plant System & equipments are designed as per the rules of Explosives Authority of India?	Yes/No
1.04.00	Whether the plant is designed for :	
	i) Continuous duty ?	Yes/No
	ii) Parallel operation of streams ?	Yes/No
	iii) Operation of electrolyser in part Load ?	Yes/No
	iv) Operation from the control panel ?	Yes/No
	v) Flexibility of isolating of any cell of electrolyser and operation for rest of the streams ?	Yes/No
	vi) Automatic operation of standby compressors?	Yes/No
	vii) Automatic change over of gas holders ?	Yes/No
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - G BID DOC. NO. : CS-0270-110-2
		
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Clause No.	BIDDER'S NAME.....			
1.05.00	Whether complete instrumentation and control system provided as specified	Yes/No		
1.06.00	Whether complete ventilation system as provided for no. of plants as specified	Yes/No		
2.00.00	EQUIPMENTS A) Rectifiers i) Make & Model No. of rectifier ii) Type of rectifier iii) Rating in (KW) B) Electrolysers i) Manufacturer ii) Capacity of the electrolyser in (Nm ³ /hr) (Rated) iii) Pressure of hydrogen gas generated (Kg/cm ² (g)) iv) Temperature of hydrogen gas generated v) Consumption of electricity in KW/NM ³ of H ₂ C) Gas holders of Hydrogen and Oxygen i) No. of gas holders offered ii) Capacity and size of each gas holder (m ³) <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div> Hydrogen </div> <div> Oxygen </div> </div>			
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - G BID DOC. NO. : CS-0270-110-2	<div style="text-align: center;">  04/0 </div>	PAGE 2 OF 4

Clause No.	BIDDER'S NAME.....	
	D) De-oxy-unit and gas cooler i) Manufacturer ii) Type iii) Capacity	
	E) Hydrogen Gas drier i) Type ii) Make	
	F) Compressors for Hydrogen i) Manufacturer ii) No. of compressor offered iii) Type of compressor iv) Delivery Pressure (Kg/cm ² (g)) v) Capacity (Nm ³ /hr) vi) Speed (rpm) vii) Type of drive viii) No. of stages of compressor	
	G) Gas Filling Manifold i) No. of Manifolds ii) No. of filling points	
	H) High pressure cylinder testing apparatus i) Manufacturer & Model No. ii) Rating of electric motor (KW)	
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - G BID DOC. NO. : CS-0270-110-2
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Clause No.	BIDDER'S NAME.....					
3.00.00	A) Cooling Water Required for Hydrogen Generation Plant per stream (M ³ /hr.)				
	B) Temperature rise (deg.C)				
4.00.00	DM water required for Hydrogen Generation Plant per stream (M ³ /hr.) at its rated capacity				
<table border="1"> <tr> <td>NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE</td> <td>TECHNICAL DATA SHEET SECTION-VI PART - G BID DOC. NO. : CS-0270-110-2</td> <td>DAS</td> <td>PAGE 4 OF 4</td> </tr> </table>			NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL DATA SHEET SECTION-VI PART - G BID DOC. NO. : CS-0270-110-2	DAS	PAGE 4 OF 4
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DATA SHEET - C


Clause No.	MOTORS		
 (Bidder's Name)		
	Applicable Data to be filled for each rating of HT, LT and DC motors		
	MOTORS		
1.00.00	GENERAL		
1.01.00	Manufacturer & Country of origin	.....
1.02.00	Equipment driven by motor	.....
1.03.00	Motor type	.....
1.04.00	Quantity	.....
2.00.00	DESIGN AND PERFORMANCE DATA		
2.01.00	Frame size	.....
2.02.00	Type of duty	.....
2.03.00	Type of enclosure and method of cooling, Degree of protection	.....
2.04.00	Applicable standard to which motor generally conforms	.....
2.05.00	Type of mounting	.....
2.06.00	Direction of rotation as viewed from DE END	.....
2.07.00	Standard continuous rating at 40 deg.C. ambient temp. (KW)	.....
2.08.00	De rated rating for specified normal condition i.e. 50 deg.C ambient temperature (KW)	.....
2.09.00	Rated Voltage (volts)	.....
2.10.00	Permissible % variation of	.....
	a) Voltage (Volts)	.....
	b) Frequency (Hz)	.....
	c) Combined voltage and frequency	.....
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - G BID DOC. NO. : CS-0270-110-2	036 MOTORS PAGE 1 OF 12

Clause No.	MOTORS		
		..... (Bidder's Name)	
2.11.00	Minimum permissible starting Voltage (Volts)	.....
2.12.00	Rated speed (RPM) at rated voltage and frequency	.....
2.13.00	At rated Voltage and frequency		
	a) Full load current (Amps)	.....
	b) No load current (Amps)	.....
2.14.00	Power Factor at		
	a) 100% load	.....
	b) NO load	.....
	c) Starting	.....
2.15.00	Efficiency at rated voltage and frequency,		
	a) 100% load	.....
	b) 75% load	.....
	c) 50% load	.....
2.16.00	Starting current (amps) at		
	a. 100 % voltage	.....
	b. 85% voltage	.....
	c. 80% voltage	.....
	d. Min permissible voltage	.....
2.17.00	Starting time (secs) with minimum permissible voltage		
	a. Without driven equipment coupled	.....
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL DATASHEET SECTION-VI PART - G BID DOC. NO. : CS-0270-110-2	 MOTORS PAGE 2 OF 12

Clause No.	MOTORS						
	 (Bidder's Name)					
2.18.00	b. With driven equipment coupled					
	Safe stall time (secs) with 100% and 110% of rated voltage						
	a. From hot condition					
	b. From cold condition					
2.19.00	Torques in Kg-m and in % of FLT						
	a. Starting torque at min. permissible voltage					
	b. Pull up torque at rated voltage					
	c. Pull out torque					
	d. Min accelerating torque (kg.m) available					
	e. Rated torque (kg.m)					
2.20.00	Stator winding DC resistance per phase (ohms at 20 Deg.C.)					
2.21.00	GD2 value of motors					
2.22.00	No of permissible successive starts when motor is in hot condition					
2.23.00	a. locked rotor KVA input					
	b. Locked rotor KVA/KW					
2.24.00	Bearings						
	a. Type					
	b. Manufacturer					
<table><tr><td>NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE</td><td>TECHNICAL DATASHEET SECTION-VI PART - G BID DOC. NO. : CS-0270-110-2</td><td>OPV: MOTORS</td><td>PAGE 3 OF 12</td></tr></table>				NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL DATASHEET SECTION-VI PART - G BID DOC. NO. : CS-0270-110-2	OPV : MOTORS	PAGE 3 OF 12
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Clause No.	MOTORS		
	 (Bidder's Name)	
	c.	Self Lubricated or forced Lubricated
	d.	Recommended Lubricants
	e.	Guaranteed Life in Hours	.....
	f.	Whether Dial Type thermometer provided	.....
	g.	Oil pressure Gauge/switch	.....
	i.	Range	.....
	ii.	Contact Nos. & ratings	.....
	iii.	Accuracy	.....
2.25.00		Vibration	
	a)	Velocity (mm/s)	.....
	b)	Displacement (microns)	.....
2.26.00		Noise level (DB) or Noise pressure or Noise power	.....
3.00.00		CONSTRUCTIONAL FEATURES	
3.01.00		Stator winding insulation / Armature winding insulation in case of	
	a.	Class & Type	.....
	b.	Tropicalised (Yes/No)	.....
	c.	Temperature rise over specified max.	
	i.	Cold water temperature of 39 DEG. C.	.....
	ii.	Ambient Air 50 DEG. C. (for air cooled motor)	.....
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - G BID DOC. NO. : CS-0270-110-2	DBB MOTORS
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Clause No.	MOTORS		
	 (Bidder's Name)	
	d.	Method of temperature measurement
	e.	Stator winding connection
	f.	Number of terminals brought out	.....
3.02.00		Type of terminal box for	
	a.	stator leads	.....
	b.	space heater	.....
	c.	Temperature detectors	.....
	d.	Instrument switch etc.	.....
3.03.00		For main terminal box	
	a.	Location	
	b.	Entry of cables	.....
	c.	Suitable for cable size (To be matched with cable size envisaged by owner)	-----Cores X -----SQMM
	d.	Fault level (MVA)	.....
3.04.00		For bearing	
	a.	Type	.....
	b.	Manufacturer	.....
	c.	Recommended lubricant	.....
	d.	Oil quantity	.....
	e.	Max cold oil temp. to bearing (deg . C)	.....
	f.	Guaranteed life in Hrs	.....
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - G BID DOC. NO. : CS-0270-110-2	 MOTORS PAGE 5 OF 12

Clause No.	MOTORS		
		..... (Bidder's Name)	
	g.	Lubrication type	.....
	h.	Whether dial type thermometer provided	.....
	i.	Oil pressure gauge/ switch	.....
3.05.00		Type of cooler	
	a.	CACA / CACW / Number for HT motors	.....
3.06.00		Cooling water requirements (if applicable)	
	a.	Quantity required (M3/hr)	.....
	b.	Maximum permissible inlet water temp. in deg.C	.....
	c.	Pressure of water (KSC) at inlet to coolers	.....
	d.	Outlet temperature (deg.C) of water at full load	.....
	e.	Cold air temp. (deg.C) at outlet	.....
3.07.00		Paint shade	.....
3.08.00		Max. permissible temperature of rotor (deg.C)	.....
3.09.00		Temp. Rise of rotor during 1st start (deg.C)	.....
3.10.00		Temp. rise of rotor during 2nd start (deg.C)	.....
3.11.00		Surge withstand voltage (stator winding) only for HT Motors	.....
	a)	0.3/3 micro sec surge (KVp)	.....
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL DATASHEET SECTION-VI PART- G BID DOC. NO. : CS-0270-110-2	076 : MOTORS PAGE 6 OF 12

Clause No.	MOTORS						
	 (Bidder's Name)					
3.12.00	b) 1.2/50 micro sec surge (KVp)					
	Weight of						
	a. Motor stator (KG)					
	b. Motor Rotor (KG)					
	c. Total weight (KG)					
4.00.00	LIST OF ACCESSORIES.						
	a) RTDs for winding for HT motors (Type/Nos/Leads/ Location/make/Res.at 0 Deg.C)					
	b) RTDs for bearing for HT motors (Type/Nos/Leads location/make/Res.at 0 Deg.C)					
	c) RTDs for Hot Air for HT motors (Type/No/Leads)					
	d) RTDs for Cold Air for HT motors (Type/No./Leads)					
	e) Space Heaters for motors beyond 30KW rating						
	i) Nos.					
	ii) Power (Watts)					
	iii) Supply Voltage					
	f) Stator Terminal Box (For HT motor)						
	i) Type					
	ii) Fault Level (MVA)					
	iii) Fault Level duration (secs)					
<table><tr><td>NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE</td><td>TECHNICAL DATASHEET SECTION-VI PART - G BID DOC. NO. : CS-0270-110-2</td><td>OPS: MOTORS</td><td>PAGE 7 OF 12</td></tr></table>				NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL DATASHEET SECTION-VI PART - G BID DOC. NO. : CS-0270-110-2	OPS : MOTORS	PAGE 7 OF 12
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Clause No.	MOTORS		
	 (Bidder's Name)	
	g) Neutral TB for HT motors		
	i) Type	
	h) Current Transformer for HT motors		
	i) Nos.		.....
	ii) Ratio		.....
	iii) Accuracy Class		.....
	iv) Knee Point Voltage-V _k (Volts)		.....
	v) Exciting Current		.....
	vi) Max Secondary Resistance		.....
	i) Dial Type Thermometer for HT motors (Type/make/Accuracy/Connection type & size		
	i) For Bearings (Nos.)		.....
	ii) For Air Temp (Nos.)		
	a. Hot Air		.....
	b. Cold Air		.....
	iii) Contact Rating		.....
	iv) Range		.....
	v) Supply Voltage		.....
	j) Rotor Terminal Box		.....
	k) TBs for RTDs. BTDs & Space Heater (Yes/No)		.....
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL DATASHEET SECTION-VI PART - G BID DOC. NO. : CS-0270-110-2	DBB : MOTORS PAGE 8 OF 12

Clause No.	MOTORS		
		..... (Bidder's Name)	
	l) Sole Plate (Yes/No)	.....
	m) Foundation & Anchoring bolts (Yes/No)	.....
	n) Base Frame (Yes/No)	.....
	o) speed switch (Yes/No)		
	i) No of contacts and contact ratings of speed switch	.....
	p) Insulation of bearing (Yes/No)	.....
	q) Forced oil lubrication (Yes/No)	.....
	r) Oil level indicator (Yes/No)	.....
	s) Noise reducer (Yes/No)	.....
	t) Flow switch for CACW motor (Quantity)		
	i) No of contacts and contact ratings	.....
	u) Water leakage detector for HT motors		
	i) No of contacts and contact ratings	.....
	v) Grounding pads		
	i) No and size on motor body	.....
	ii) Nos on terminal Box	.....
	w) Vibration pads		
	i) No and size	.....
	ii) Location	.....
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL DATASHEET SECTION-VI PART - G BID DOC. NO. : CS-0270-110-2	999 : MOTORS PAGE 9 OF 12


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Clause No.	MOTORS		
	 (Bidder's Name)	
5.00.00	x) Any other fitments	
	LIST OF CURVES		
	i. Torque speed characteristic of the motor	
	ii. Calibration characteristic of platinum type resistance temperature detector	.....
	iii. Calibration characteristic of platinum BTD	.....
	iv. Thermal withstand characteristic	.....
	v. starting current Vs. Time	.....
	vi. starting. current Vs speed	.....
	vii. Neg. sequence current vs Time	.....
	viii. P.F. and Effi. Vs Load	.....
6.00.00	Additional Data to be filled for each rating of DC Motor		
6.01.00	Rated armature voltage (Volt)	.....
6.02.00	Rated field excitation (Amp)	.....
6.03.00	Permissible % variation in voltage	.....
6.04.00	Minimum Permissible Starting voltage (volt)	.....
6.05.00	At rated voltage		
	i) Full load Armature current. (Amp)	.....
	ii) Full load Field current (Amp)	.....
	iii) No load Armature current (Amp)	.....
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL DATASHEET SECTION-VI PART - G BID DOC. NO. : CS-0270-110-2	<div> <div></div> <div>MOTORS</div> </div> <div>PAGE 10 OF 12</div>

Clause No.	MOTORS		
		..... (Bidder's Name)	
6.06.00	Full load Field current (Amp)	.....
6.07.00	No load Armature current (Amp)	.....
6.08.00	Minimum permissible field current (Amp) to avoid overspeeding at		
	i) Maximum permissible voltage	.....
	ii) Rated voltage	.....
	iii) Minimum Permissible Voltage	.....
6.09.00	Resistance (indicative Values) in ohm		
	i) Armature winding (Arm + IP + Series) at 25 deg.C	.....
	ii) Field Winding at 25 deg. C	.....
6.10.00	Inductance (indicative values)		
	i) Armature winding	.....
	ii) Field winding	.....
6.11.00	Value of trimmer resistance (ohm) to be connected in series with the shunt field to obtain rated speed at		
	i) 220 V DC	.....
	ii) 220 V DC + 10 % DC	.....
	iii) 220 V - 15% DC	.....
6.12.00	Value of the external resistance (ohm) required to be connected in series with armature during starting only	.....
6.13.00	Technical data sheet for external resistance box	.....
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL DATASHEET SECTION-VI PART - G BID DOC. NO. : CS-0270-110-2	OPP MOTORS PAGE 11 OF 12

Clause No.	MOTORS		
6.14.00 6.15.00 6.16.00 6.17.00 6.18.00		<div>.....</div> <div>(Bidder's Name)</div>	
	Terminal box arrangement	.....
	GA drawing of motor	.....
	Starting time calculation	.....
	Starter resistance design calculation	.....
	Electrical connection diagram of motor	.....
NABINAGAR THERMAL POWER PROJECT (4 X 250 MW) STEAM TURBINE GENERATOR PACKAGE		TECHNICAL DATASHEET SECTION-VI PART - G BID DOC. NO. : CS-0270-110-2	<div>BID</div> MOTORS <div>PAGE 12 OF 12</div>

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	TITLE: TECHNICAL SPECIFICATION FOR HYDROGEN GENERATION PLANT 4X250 MW, NABINAGAR THERMAL POWER PLANT	SPEC. NO. PE-TS-300-168-A000	
		VOLUME II-B	
		SECTION	
		REV. NO. 0	DATE:
		SHEET	OF

SECTION – E

P&ID FOR HYDROGEN GENERATION PLANT
BHEL DRG NO. - PE-DG-300-168-A001 (REV 00)

