2X 800 MW NTPC GADERWARA STPP STAGE-I

VOLUME - II B

TECHNICAL SPECIFICATION

FOR

HYDROGEN GENERATION PLANT

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

BHARAT HEAVY ELECTRICALS LIMITED
POWER GROUP
PROJECT ENGINEERING MANAGEMENT
NEW DELHI (INDIA)

SECTION – A

SCOPE OF ENQUIRY

1. SCOPE OF ENQUIRY

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

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

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

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

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

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

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

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

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

SECTION B
PROJECT INFORMATION

INTRODUCTION

1.00.00 **BACKGROUND**

Gadarwara Thermal Power Project (Gadarwara TPP) is being set up as a regional power project for the benefit of States/UTs of Western Region. This project is being set up in two stages. Each stage shall comprise of two units of 800 MW.

1.01.00 **Location and**

The site is located near villages Gangai & Umaraiya (about 9 Kms from Gadarwara town in Narsingpur district of Madhya Pradesh.The major cities Bhopal & Jabalpur are located at about 210 Kms & about 140 kms respectively from proposed project site. The nearest BG Railway Station, Gadarwara, on Jabalpur- Itarsi Section on central railway main Line is about 9 Kms from proposed project site.

The nearest commercial airport, Bhopal and Jabalpur are located about 240 Kms and about 155 Kms respectively from site. The plant latitude and longitude are 22° 51' 42" N and 78° 52' 08" respectively.

Vicinity plan of the proposed project is placed at **Annexure –A-I**

1.02.00 **Land**

About 1844 acres of land (Private Land- about 1480 acres nd Govt. Land- about 364 acres) has been envisaged for the project. In-principle land availability clearance has been obtained from Govt. of Madhya Pradesh vide letter dated 19.05.08.

1.03.00 **Water**

The make-up water requirement is estimated as 4680 Cubic Meter/Hr with ash circulation system and about 5980 Cubic Meter/Hr with once through ash water system. The source of water for the Project is Narmada River at a distance of about 30 Kms from the project site.

Govt. of Madhya Pradesh vide dated 19.05.08.has accorded water commitment from Narmada river for the project. CWC vide letter dated 27.07.12 have concurred water availability confirmation accorded by State Govt.

1.04.00 **Capacity**

2 x 800 MW - Present proposal

2 x 800 MW - In Future

1.05.00 **Meteorological data**

Important meteorological data from nearest observatory at Narsinghpur is placed at **Annexure-A-II.**

1.06.00 **Plant Water Scheme**

The Plant water scheme is described below.

1.06.01 **Condenser Cooling (CW) Water System**

It is proposed to provide recirculating type CW system with induced draft type cooling towers. For the recirculating type CW system it is proposed to supply clarified water as make up. Raw water from the make-up water pump house shall be pumped to a Water Pretreatment Plant (PT - CW system). The treated clarified water shall be led to the cold water channel of CW system. Designed Clarified Water Analysis is given in this subsection.CW system shall be operated at a C.O.C of about 4.0. Chemical treatment programme (using acid dosing and scale cum corrosion inhibitors dosing) may be employed in addition to blow down of CW water to control the CW system chemistry in case CW system is required to be operated beyond 4.0 COC. CW blow down shall be drawn from the discharge of CW pumps and the same shall be led to a Service water Tank. For carrying circulating water from CW pump house to TG-area and from TG area to cooling tower, steel lined concrete encased duct would be provided. For interconnecting CW duct with CW pump, condenser and cooling towers, steel pipes would be used. Cooled water from cooling tower will be led to CW pump house through the cold water channel by gravity.

1.06.02 **Equipment Cooling Water (ECW) System (Unit Auxiliaries)**

The plant auxiliaries of Steam Generator and Turbine Generator shall be cooled by Demineralised (DM) water in a closed circuit. The primary circuit DM water shall be cooled through plate type heat exchangers by Circulating Water tapped from CW system in a closed secondary circuit. The hot secondary circuit cooling water shall be cooled in the cooling towers and shall be returned back to the system. It is proposed to provide independent primary cooling water circuit for Steam Generator & auxiliaries and TG & its auxiliaries.

1.06.03 **Station Auxiliaries Cooling Water System**

The station auxiliaries such as Air compressors, Compressors of ash handling plant, Cooling water circuit of Air Conditioning system, compressor of mill reject system etc. shall be cooled by separate cooling water System using separate set of pumps and cooling towers.

1.06.04 **Ash Water System**

It is proposed to operate ash water system in a closed circuit. The ash water from the ash dyke shall be recirculated after treating a part of the quantity in a side stream lime softening plant as the case may be. Make up to the ash water system (to compensate for the ash water system blow down and evaporation loss in ash dyke) shall be supplied from excess CW blow down water (Service water) and raw water supply from water source of the plant. In addition, provision shall be kept to supply treated water from Central Monitoring Basin of Liquid Effluent Treatment Plant.

1.06.05 **Other Miscellaneous Water Systems**

a) CW system blow down water shall be used for the plant service water requirement, dust suppression system of coal handling plant, makeup to the Ventilation system, ash slurry pumps sealing, sealing of Vacuum pumps (if applicable) of Ash Handling plant, make-up to fire water storage tanks and cooling water requirement of hydrogen generation plant. The service (wash water) water collected from various areas shall be treated using oil water separators, tube settlers, coal settling pits etc. as per requirement and treated water from liquid effluent treatment plant shall be recycled back to the service water system for re-use. The excess service water shall be led to central monitoring basin for disposal.

b) Separate water Pre-treatment plants are proposed for Circulating Water (PT-CW) system, Demineralisation Plant (PT-DM) plant and potable (PT-Pot) water systems.

c) The drinking water requirement of the plant and colony shall be provided from the above mentioned Water (PT-Pot) pretreatment plant.

d) Steam Cycle make-up water, makeup to the primary circuit of ECW (unit auxiliaries) system, boiler fill water and makeup to the hydrogen generation plant shall be provided from Demineralising plant.

e) The quality of clarified water & DM water is given in this sub-section at **Annexure-A-III**.

1.07.00 **Criteria for Earthquake Resistant Design of Structures and Equipment**

All power plant structures and equipment, including plant auxiliary structures and equipment shall be designed as per the criteria specified in sub-section-D1 of Section-VI (Part-A).

In case the acceleration criteria considered by the Bidder for the design of anchorage bolts of Steam Turbine and Generator with TG Deck in his bid is different with respect to above criteria, he shall indicate the same in his bid. The same will be discussed with the Bidder and finalized considering the following:

a) The earthquake design acceleration for the steam turbine and generator acting at the centre of gravity depends upon the layout/configuration/size of TG deck supporting columns and beams which are to be jointly decided by NTPC and the bidder.

b) As the data regarding Foundation GA & loading data to be furnished by Bidder may not be available at tender stage, the acceleration criteria proposed by the bidder can not be confirmed for acceptance at the award stage. The same can be confirmed after jointly finalizing the TG substructure arrangement by NTPC and Bidder.

c) TG deck acceleration values will be limited to the design values adopted by Bidder by suitably increasing the size of the TG supporting columns/beams during detailed engineering.

Accordingly Bidder has to make equipment/piping layout clearing the TG column/beams.

1.08.00 **Criteria for Wind Resistant Design of Structures and Equipment**

All structures and equipment of the power plant, including plant auxiliary structures and equipment, shall be designed for wind forces as given as given in sub-section-D1 of Section-VI (Part-A).

SECTION–C1

SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

GENERAL:

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

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

A) Major Mechanical scope:-

1) Two streams of electrolysers working in parallel (each of capacity minimum 10 Nm3/hr.).
2) Three (3) numbers of hydrogen gas compressors and drives (each of minimum capacity 12.5 Nm3/hr) with cell purging system, mixing tank, DM tank, pumps to handle electrolyte and its filters, gas washing system, two gas holders each of minimum capacity 20 Nm3 wherever applicable.
3) 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.
4) Bidder shall include vacuum pump and high-pressure cylinder testing apparatus along with all accessories for testing cylinders.
5) Bidder to include the Ventilation Requirement for hazardous and non-hazardous area including toilets in his scope for the H2 Plant building as per the requirement specified in the clause number 4.00.00, section D1 of technical specification. Bidder shall also include in his scope window Air-conditioners for his control Panels etc. Bidder to specify the same in his offer.
6) Feed water / Cooling water:
   FEED WATER: - Bidder shall be given DM water for hydrogen generation and cooling purpose (at the required rate at 1 kg/cm2 (min) at one point near hydrogen generation plant building (10 m). Further distribution shall be in bidder's scope.
   COOLING WATER: - Service water shall be used as cooling water and shall be terminated at a distance of 10m from the hydrogen plant building at ambient temperature and pressure of 1 kg/cm2(min) and the same may be used as cooling water. The Cooling Water analysis is attached with this technical specification as Annexure 2. If the bidder finds the analysis of cooling water is not suitable for their system, bidder shall provide closed loop cooling with passivated DM water as make up. Bidder to include in his scope all the equipment and accessories required for closed loop cooling and passivation of DM water. Bidder shall indicate DM water make up requirements in the technical offer in case they adopt closed loop cooling with passivated DM water. Further distribution of cooling water to cells, compressor & other auxiliaries within the plant shall be in bidder's scope.
7) 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.
8) 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.
9) Bidder shall also provide connection, isolation device, manifold, piping etc. for N2 gas connection to cell system for purging.
10) Bidder to note that N2 gas required for purging the system during commissioning/demonstration test/trial operation etc. till handing over the plant to CUSTOMER shall be arranged by bidder.

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

B) Electrical scope:

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

C) Control and instrumentation scope:

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

D) Civil scope:

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

E) COMMISSIONING SPARES

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

F) RECOMMENDED SPARES

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

G) QUALITY ASSURANCE PLANS

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

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

H) SUB VENDOR:

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

I) DEMONSTRATION TEST:

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

J) TERMINAL POINTS

Feed water / cooling water:

TP1:- Feed water (Refer annexure – 1, section C1 for the feed water analysis):- Bidder to note that the DM quality feed water shall be terminated at one point (10 meter from hydrogen generation plant building) for hydrogen generation. Further distribution of DM feed water shall be in bidders scope.
TP2:- Cooling water (Refer annexure – 2, section C1 for the cooling water analysis):- Service water used in the shall be terminated at a distance of 10 m from the hydrogen plant building at ambient temperature and pressure of 1 kg/cm2 (min) and the same may be used as cooling water. The Cooling Water analysis is attached with this technical specification as Annexure 2. If the bidder finds the analysis of circulating water is not suitable for their system, bidder shall provide closed loop cooling with passivated DM water as make up. Bidder to include in his scope all the equipments and accessories required for closed loop cooling and passivation of DM water. Bidder to also state their DM water make up requirements in case they adopt closed loop cooling with passivated DM water. Further distribution of cooling water to cells, compressor & other auxiliaries within the plant shall be in bidder's scope.
Note:- Bidder to note that the temperature of feed water / cooling water at terminal point 1 and 2 shall be as per ambient conditions
TP-3:- Bidder to note that both Instrument and service air shall be terminated at one point (10 meter from hydrogen generation plant building) for hydrogen generation. Further distribution of Instrument and service air shall be in bidder's scope.
TP4:- Drains:- All drains shall be terminated at one point by bidder.

K) Painting:

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

L) DRAWINGS/DOCUMENTATION

Drawing/documents requirement (No. of hard copies/CD-ROM/floppies) shall be as stated drawing document distribution schedule, section C1 of technical specification. Bidder to note that all the drawings/documents including Process & instrumentation diagram, layout, piping, equipment data sheet, foundation drawing, control & instrumentation, general arrangement drawings, field quality plan, quality plan, erection drawings, 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 woks for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The bidder without any extra charge shall provide the same.

N) POWER LOADING CRITERIA:

Sl.No.	Description	Gaderwara
1	Rate of loading during evaluation (per KW) (Refer note 1&2)	US $ 2007
2	Rate of penalty during PG test (per KW) (Refer note 1 & 2)	US $ 2845

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

Note 2: Bidder shall submit format for guarantee power consumption in the format attached in, section-C1, duly filled in all respects along with the priced bid. The net differential loading amount (worked out in the following manner) will be added with respective bidder's total quoted price to derive the total price for evaluation. 1/3 of consumption in KW quoted by the bidder in the format shall be loaded by the above indicated figure in s.no.1 for each KW increase in total consumption from base figure of 39 KW. In case the successful bidder fails to establish/ prove the guaranteed values of power consumption on actual performance testing at the manufacturing works/ site, penalty by above indicated figure in s.no.2 per KW increases in power consumption shall be levied.

O) Mandatory Spares:

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

ANNEXURE 1

DM WATER ANALYSIS

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

ANNEXURE-2

COOLING WATER ANALYSIS

COOLING WATER ANALYSIS

Sl. No.	Constituent	as	mg per litre
1.	Calcium	$CaCO_3$	112
2.	Magnesium	$CaCO_3$	66
3.	Sodium + Potassium	$CaCO_3$	49
	Total Cations	$CaCO_3$	28
4.	Total Alkalinity	$CaCO_3$	137
5.	Chloride	$CaCO_3$	48
6.	Sulphate	$CaCO_3$	44
	Total Anions	$CaCO_3$	228
7.	Silica (Reactive)	Si	10
8.	Iron (total)	Fe	0.3 mg/l
9.	pH Value	-	7.7 - 8.0
10.	Organics (KMnO4)		2
11.	Turbidity	NTU	Upto 500

ANNEXURE 3

GUARANTEED PERFORMANCE DATA

SL.NO	DESCRIPTION	PARAMETER
	BHEL Job Number	394
1	Hydrogen generation plant Minimum capacity (Nm3/hr.)	20
2	Number of streams (2X50%)	2
3	Minimum Capacity of each Streams/electrolyser (Nm3/hr.)	10
4	Hydrogen purity (%) at gas manifolds	99.9
5	Moisture content - gm/m3 (max)	0.05
6	Design delivery pressure at its rated duty point Kg/cm2 (g)	150
7	Minimum capacity of each Compressor (Nm3/hr.)	125% of rated Capacity of each Streams/electrolyser (Nm3/hr.)
8	Vibration level of compressor	As per internationally accepted standard
9	Noise level of compressor	85 dBA (to a reference of 0.0002 micro bar).

QUALITY ASSURANCE PLANS

9.00.00 **QUALITY ASSURANCE PROGRAMME**

9.01.00 The Contractor shall adopt suitable quality assurance programme to ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with ISO-9001.A quality assurance programme of the contractor shall generally cover the following:

(a.) His organisation structure for the management and implementation of the proposed quality assurance programme

(b.) Quality System Manual

(c.) Design Control System

(d.) Documentation and Data Control System

(e.) Qualification data for bidder's key personnel.

(f.) The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.

(g.) System for shop manufacturing and site erection controls including process, fabrication and assembly.

(h.) Control of non-conforming items and system for corrective actions and resolution of deviations.

(i.) Inspection and test procedure both for manufacture and field activities.

(j.) Control of calibration and testing of measuring testing equipment.

(k.) System for Quality Audits.

(l.) System for identification and appraisal of inspection status.

(m.) System for authorising release of manufactured product to the Employer.

(n.) System for handling, storage and delivery.

(o.) System for maintenance of records, and

(p.) Quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component.

9.02.00 **GENERAL REQUIREMENTS - QUALITY ASSURANCE**

9.02.01 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification which shall be finalised giving due consideration to the manufacturer's standard and proven practices being followed. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award. Monthly progress reports on MQP/FQP submission/approval shall be furnished on enclosed format No. QS-01-QAI-P-02/F1.

9.02.02 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media through c-folders, a web based system of NTPC ERP in addition to hard copy, for

	review and approval. After approval the same shall be submitted in compiled form on CD-ROM.
9.02.03	Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site.
9.02.04	The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.
9.02.05	No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to predespatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC).
9.02.06	All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties; chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.
9.02.07	The contractor shall submit to the Employer Field Welding Schedule for field welding activities in the enclosed format No.: QS-01-QAI-P-02/F2. The field welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site.
9.02.08	All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer.

	All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.
9.02.09	All brazers, welders and welding operators employed on any part of the contract either in Contractor's/sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.
9.02.10	Welding procedure qualification & Welder qualification test results shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorised representative.
9.02.11	For all IBR pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. However, for other piping systems ASME B31.1 or other relevant code as applicable shall be followed. Similarly, any other statutory requirements for the equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding.
9.02.12	Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.
9.02.13	No welding shall be carried out on cast iron components for repair.
9.02.14	All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
9.02.15	All non-destructive examination shall be performed in accordance with written procedures as per International Standards, The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination) / EN / Equivalent. NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job. All plates of thickness above 40mm & all bar stock/Forging above 40mm dia shall be ultrasonically tested. For pressure parts, plate of thickness equal to or above 25mm shall be ultrasonically tested.
9.02.16	The Contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the

	sub-contractor proposed by the Contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/ equipment etc., list of which shall be drawn up by the Contractor and finalised with the Employer, shall be subject to Employer's approval. The contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion and identified in "DR" category prior to any procurement. Monthly progress reports on sub-contractor detail submission / approval shall be furnished on enclosed on format no. QS-01-QAI-P-02/F1. Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.
9.02.17	For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. With in three weeks of the release of the purchase orders / contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the monthly basis by the Contractor along with a report of the Purchase Order placed so far for the contract.
9.02.18	Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-contractor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.
9.02.19	The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in

	the specification, in addition to carrying out tests as per the approved quality plan.
9.02.20	Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.
9.02.21	For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.
9.02.22	Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.
9.02.23	Environmental Stress Screening All solid state electronic system / equipment / sub assembly shall be free from infant mortile components. For establishing the compliance to this requirement, the contractor / sub - contractor should meet the following. 1) The Contractor / Sub - contractor shall furnish the established procedure being followed for eliminating infant mortile components. The procedure followed by the Contractor / Sub - contractor should be substantiated along with the statistical figures to validate the procedure being followed. The necessary details as required under this clause shall be furnished at the stage of QP finalization. Or In case the Contractor / Sub - contractor do not have any established procedure to eliminate infant mortile components then two or 10% which ever is less, most densely populated Panels shall be tested for Elevated Temperature Cycle Test as per the following procedure. Elevated Temperature Test Cycle During the elevated temperature test which shall be for 48 hours, the ambient temperature shall be maintained at 50° C. The equipment shall be interconnected with devices and kept under energized conditions so as to repeatedly perform all operations it is expected to perform in

actual service with load on various components being equal to those which will be experienced in actual service.

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

In case of any failure during the test cycle, the further course of action should be mutually discussed for demonstrating the intent of the above requirement.

2) Burn in Test Cycle

The test shall be conducted on all the panels fully assembled and wired including the panels having undergone the above mentioned elevated temperature test.

The period of Burn in Test Cycle shall be 120 hrs and process shall be similar to the elevated temperature test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time.

During the above tests, the process I/O and other load on the system shall be simulated by simulated inputs and in the case of control systems; the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable.

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

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

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
9.03.00	**QA DOCUMENTATION PACKAGE** The Contractor shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (✓) mark.
9.03.01	Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document. The QA Documentation file shall be progressively completed by the Supplier's sub- supplier to allow regular reviews by all parties during the manufacturing. The final quality document will be compiled and issued at the final assembly place of equipment before despatch. However CD-Rom may be issued not later than three weeks.
9.03.02	Typical contents of QA Documentation is as below:- (a.) Quality Plan (b.) Material mill test reports on components as specified by the specification and approved Quality Plans. (c.) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans. (d.) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment. (e.) Heat Treatment Certificate/Record (Time- temperature Chart) (f.) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure). (g.) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points. (h.) Certificate of Conformance (COC) wherever applicable. (i.) MDCC

9.03.03 NOT USED.

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

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

(a.) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.

(b.) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.

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

9.03.06 **TRANSMISSION OF QA DOCUMENTATION**

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

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

9.04.00 **Project Manager's Supervision**

9.04.01 To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Project Manager and without prejudice to the provisions of 'Arbitration' clause in Section GCC of Vol.I, the Contractor shall proceed to comply with the Project Manager's decision.

9.04.02 The work shall be performed under the supervision of the Project Manager. The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following:

(a.) Interpretation of all the terms and conditions of these documents and specifications:

(b.) Review and interpretation of all the Contractor's drawing, engineering data, etc:

(c.) Witness or his authorised representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract :

(d.) Inspect, accept or reject any equipment, material and work under the contract:

(e.) Issue certificate of acceptance and/or progressive payment and final payment certificates

(f.) Review and suggest modifications and improvement in completion schedules from time to time, and

(g.) Supervise Quality Assurance Programme implementation at all stages of the works.

9.05.00 **INSPECTION, TESTING AND INSPECTION CERTIFICATES**

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

9.05.02 The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all

	reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.
9.05.03	The Contractor shall give the Project Manager/Inspector ten (10) working days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within ten (10) working days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.
9.05.04	The Project Manager or Inspector shall within ten (10) working days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.
9.05.05	When the factory tests have been completed at the Contractor's or sub-contractor's works, the Project Manager /Inspector shall issue a certificate to this effect ten (10) working days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within ten (10) working days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.
9.05.06	In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the

	Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.
9.05.07	The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.
9.05.08	To facilitate advance planning of inspection in addition to giving inspection notice as specified at clause no 9.05.03- of this chapter, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.
9.05.09	All inspection, measuring and test equipment used by contractor shall be calibrated periodically depending on its use and criticality of the test/ measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.
9.06.00	**ASSOCIATED DOCUMENT FOR QUALITY ASSURANCE PROGRAMME:**
9.06.01	List of items requiring Quality Plan & Sub-supplier approval. Format No. QS-01-QAI-P-01/F3-R0
9.06.02	Status of Quality Plan and Sub-supplier approval Format No. QS-01-QAI-P-02/F1-R0
9.06.03	Field Welding Schedule Format No.: QS-01-QAI-P-02/F2-R0
9.06.04	Manufacturing Quality Plan Format No.: QS-01-QAI-P-09/F1-R0
9.06.05	Field Quality Plan Format No.: QS-01-QAI-P-09/F2-R0
	The above formats are enclosed as Annexure-III to VII

HYDROGEN GENERATION PLANT

HYDROGEN GENERATION PLANT-TESTS

TESTS/CHECK / ITEM / COMPONENTS	Material Test	WPS/PQR/Welder Qualification	DPT/MPI	Ultrasonic test	RT	Pneumatic test	Hydraulic/Water Fill tests	Assembly/fit up	Dimension	Functional/operational tests	Performance tests	Other tests	Remarks
H2 PLANT													
A. COMPRESSOR								Y		Y	Y		
1) Casing	Y[3]												
2) Crank shaft/ connecting rod	Y[3]		Y	Y					Y				
3) Piston/Diaphragm			Y[3]							Y			
B. DRYING PLANT							Y						
1) Raw material identification	Y[3]		Y[1]		Y[2]								
C. HYDROGEN GENERATOR							Y			Y	Y		
D. CELL MODULE							Y			Y	Y		
E. GAS HOLDER	Y[3]						Y						

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.

INDUCTION MOTOR & SYNCHRONOUS MACHINE

TESTS/CHECKS / TEMS/COMPONENTS	Visual	Dimensional	Make/Type/Rating/TC/General Physical Inspection	Mech/Chem. Properties	NDT /DP/MPI/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment	Magnetic Characteristics	Hydrualic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	All tests as per IS-325/IS-4722 / 9283	Vibration	Over speed	Tan delta, shaft voltage & polarisation index test
Plates for stator frame, end shield, spider etc.	Y	Y	Y	Y					Y									
Shaft	Y	Y	Y	Y	Y	Y			Y									
Magnetic Material	Y	Y	Y	Y	Y		Y			Y		Y						
Rotor Copper/Aluminium	Y	Y	Y	Y		Y	Y		Y									
Stator copper	Y	Y	Y	Y			Y		Y			Y						
SC Ring	Y	Y	Y	Y	Y	Y	Y	Y	Y									
Insulating Material	Y		Y	Y			Y					Y						
Tubes for Cooler	Y	Y	Y	Y	Y				Y		Y							
Sleeve Bearing	Y	Y	Y	Y	Y				Y		Y							
Stator/Rotor, Exciter Coils	Y	Y	Y				Y	Y										
Castings, stator frame, terminal box and bearing housing etc.	Y	Y	Y	Y	Y			Y										
Fabrication & machining of stator, rotor, terminal box	Y	Y			Y				Y									
Wound stator	Y	Y					Y	Y										
Wound Exciter	Y	Y					Y	Y										
Rotor complete	Y	Y					Y						Y	Y				
Exciter, Stator, Rotor, Terminal Box assembly	Y	Y					Y											
Accessories, RTD, BTD,CT, Brushes, Diodes,Space heater, antifriction bearing, cable glands, lugs, gaskets etc.	Y	Y	Y															
Motor (IS 325 / 4722/ 9283)	Y	Y	Y												Y	Y	Y	Y1

Note: 1. This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed along with relevant supporting documents during QP finalization. However, No QP for LT motor up to 50KW.

2. Makes of all major bought out items will be subject to NTPC approval.

Y1 = for HT Motor / Machines only.

L.T. POWER CABLES
(1.1 KV PVC & XLPE CABLES)

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

Note: This is an indicative list of test/checks. The manufacturer is to furnish a detailed quality plan indicating the practice and procedure along with relevant supporting documents.

* 2. Not applicable for XLPE insulation

	ROUTINE TESTS **Routine tests shall be carried out on each drum of finished cables for all types & sizes.** **Following shall constitute routine tests:**
1)	Conductor Resistance test
2)	High voltage test at room temperature

	ACCEPTANCE TESTS	
	Following Acceptance tests shall be carried out for each type and size of the cables on the cable drums selected at random as per sampling plan mentioned in IS: 1554 Part 1 & IS 7098 Part-I	
A)	**For Conductor**	
1)	Annealing test	For copper conductor only
2)	Tensile test	For aluminium conductor only
3)	Wrapping test	For aluminium conductor only
4)	Resistance test	
B)	**For Armour Wires / Formed Wires (If applicable**)	
1)	Measurement of Dimensions	
2)	Tensile Tests	
3)	Elongation Test	
4)	Torsion Test	For Round wires only
5)	Wrapping Test	
6)	Resistance Test	
7)	Mass of Zinc coating test	For G S wires / Formed wires only

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

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

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

- 1.Note : This is an indicative list of test/checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and procedure along with relevant supporting documents.

CONTROL CABLE

ROUTINE TESTS

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

Following shall constitute routine tests:

1) Conductor Resistance test

2) High voltage test at room temperature

ACCEPTANCE TESTS

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

A) For Conductor

1) Annealing test — For copper conductor only

2) Resistance test

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

1) Measurement of Dimensions

2) Tensile Tests

3) Elongation Test

4) Torsion Test — For Round wires only

5) Wrapping Test

6) Resistance Test

7) Mass of Zinc coating test — For G S wires / Formed wires only

8) Uniformity of Zinc coating — For G S wires / Formed wires only

9) Adhesion test — For G S wires / Formed wires only

10) Freedom from defects

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

INSTRUMENTATION CABLE

TESTS / ITEMS	Conductor Resistance ® & (A)	High Voltage ® & (A)	Insulation Resistance ® & (A)	Constructional detail, dimensions (A)	Outer-Sheathe/core marking, end sealing (A)	Thermal Stability (A) +	Visual, Surface finish (A) +	Electrical Parameters ** (A) +	Persulphate Test (A) +	Overall/Coverage/Continuity (A)	Swidesh chimney Test (SS-4241475) (A) ++	FRLS Test * (A) ++	Tensile & Elongation before & after aging (A) ++	Vol. Resistivity. at room & Elevated Temp. (A) ++	Spark test report review ®
1. Instrument cable twisted and shielded															
Conductor(IS-8130)	Y			Y			Y								
Insulation(VDE-207)				Y	Y	Y	Y						Y		Y
Pairing/Twisting				Y	Y		Y								
Shielding				Y			Y			Y					
Drain wire	Y			Y			Y		Y	Y					
Inner Sheath				Y	Y	Y	Y					Y	Y		
Outer Sheath				Y	Y	Y	Y					Y	Y		
Over all cable	Y	Y	Y	Y	Y		Y	Y			Y			Y	
Cable Drums(IS-10418)				Y			Y								

Note : High Temp. cables shall be subjected to tests as per VDE-207(Part-6) Compensating cables shall be checked for Thermal EMF/Endurance test as per IS 8784.

Note : This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating his practice & Procedure along with relevant supporting documents during QP finalization for all items.

Note : ® - Routine Test A - Acceptance Test Y - Test Applicable

Note : Sampling Plan for Acceptance test shall be as per IS 8784 (As applicable)

- * FRLS Tests: Oxygen / Temp Index (ASTM D-2863), Smoke Density Rating (ASTM – D 2843), HCL Emission (IEC-754-1)
- ** Characterisitic Impedence, Attenuation, Mutual Capacitance, Cross Talk (As applicable)

\+ Sample size will be One No. of each size/type per lot.

++ Sample size will be One No. sample for complete lot offered irrespective of size/type.

LIGHTING

Item Components / Sub System / Assembly — Attributes / Characteristics	Make, Type , Rating/ TC	Dimension	Pre-Treatment of sheets	Paint Shade Thickness Adhesion & Finish	Test for Galvanization	IP Test	Bought Out Items/ Bill of Material	HV & IR	Functional Check as per spec.	Constructional Feature as per NTPC spec.	Routine Test as per relevant std and spec	Acceptance Test as per relevant std and spec	Item to conform to relevant standard
Luminaries (IS-10322 Part-5 Sec.1; IS- 2206)	Y					Y		Y			Y	Y	
Electronic Ballast	Y										Y	Y	Y
Lighting Wire (IS-694)	Y										Y		
Pole (IS-2713)	Y			Y						Y	Y	Y	
Lamps (IS-9800, IS-9974)	Y										Y	Y	
Switch Box/ Junction Box/Receptacles/ Local Push Button, Lighting Panel / flame proof type (IS-513, 2629, 2633, 4759, 6745, 2148)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Cable Gland (BS-6121)	Y	Y									Y		
Cable Lug (IS-8309)	Y	Y									Y		
Flexible Conduit	Y										Y		
Lighting Transformer (IS-1117, 11333)	Y									Y	Y		
Epoxy & Galvanised Conduit (IS-9537, 2629, 2633, 4759, 6745)	Y	Y									Y		Y

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

CABLING, EARTHING, LIGHTNING PROTECTION

ATTRIBUTES / CHARACTERISTICS ITEMS/COMPONENTS / SUB SYSTEMS	Dimension	Paint shade, paint thickness, adhesion	Pre-treatment of sheet	IP protection	Proof load*	Surface finish	Deflection test*	HV & IR	Galvanise Test (If Applicable)	Functional	Bought out items/Bill of material	Routine tests as per relevant standard & specification	Acceptance tests as per relevant standard & specification	Constructional feature as per NTPC
Cable glands(BS-6121)	Y											Y		
Cable lug(IS-8309)	Y											Y		
Lighting wire(IS-694)	Y											Y		
Flexible conduits	Y											Y		Y
Conduits(Galvanized & Epoxy) IS-9537 & IS-2629,2633 ,6745	Y		Y								Y	Y		Y
RCC Hume Pipe (IS-458)												Y		
Cable straight through joint (VDE-0278)	Y											Y		Y
Cable Trays, & supports system & accessories IS-513, 2629,2633,6745	Y		Y		Y	Y	Y	Y	Y	Y		Y	Y	Y
Trefoil clamp	Y													Y
GI flats for earthing & lighting protection (IS 2062, 2629, 6745,2633)	Y		Y						Y			Y		Y
GI wire (IS-280)	Y											Y		
Fire Sealing System (BS – 476)												Y	Y	Y

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

LT SWITCHGEAR

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

ATTRIBUTES / CHARACTERIS-TICS → / ↓ **ITEMS/ COMPONENTS/ SUB SYSTEM ASSEMBLIY**	Make, Model, Type, Rating & TC	Dimensions & Finish	Electrical properties	Mechanical Properties	Chemical properties	Functional & Operational Features as per NTPC Spec.	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint Shade, Adhesion, Thickness & Finish	Functional Checks	Milli-volt drop Test	IR – HV – IR Test	Degree of Protection Routine test as per NTPC spec	All Routine tests as per NTPC spec. & IS
Sheet Steel (IS : 513)	Y	Y		Y	Y		Y							
Aluminum Bus bar Material (IS : 5082)	Y	Y	Y	Y	Y		Y							
Copper Bus bar Material (IS : 613)	Y	Y	Y	Y	Y		Y							
Support Insulator	Y	Y	Y	Y			Y							
Air Circuit Breaker (IS: 13947)	Y	Y				Y	Y			Y	Y			Y
Energy Meters (IS : 13010, 13779)	Y	Y				Y	Y			Y				Y
Power & Aux. Contactors (IS : 13947)	Y	Y				Y	Y			Y				
Protection & Aux. Relays (IS : 3231)	Y	Y				Y	Y			Y				Y
Control & Selector Switches IS : 13947)	Y	Y				Y	Y			Y				
CT's & PT's (IS 2705 / 3156)	Y	Y					Y							Y
MCCB (IS : 13947)	Y	Y					Y			Y				
Indicating Meters (IS : 1248)	Y	Y				Y	Y			Y				Y
Indicating Lamps (IS : 13947)	Y	Y				Y	Y			Y				
Air Break Switches (IS : 13947)	Y	Y				Y	Y			Y				
Control Terminal Blocks	Y	Y				Y	Y							

LT SWITCHGEAR

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

ATTRIBUTES / CHARACTERI S-TICS → **ITEMS/ COMPONENTS/ SUB SYSTEM ASSEMBLIY** ↓	Make, Model, Type, Rating & TC	Dimensions & Finish	Electrical properties	Mechanical Properties	Chemical properties	Functional & Operational Features as per NTPC Spec.	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint Shade, Adhesion, Thickness & Finish	Functional Checks	Milli-volt drop Test	IR – HV – IR Test	Degree of Protection Routine test as per NTPC spec	All Routine tests as per NTPC spec. & IS
Fuse (IS 13703)	Y	Y				Y	Y							
Control Transformer (IS : 12021)	Y	Y				Y	Y			Y				Y
Push Buttons (IS : 4794)	Y	Y				Y	Y			Y				
Transducer (IEC : 60688)	Y	Y				Y	Y			Y				Y
MCB IS : 8828)	Y	Y				Y	Y			Y				
Breaker Handling Trolley	Y	Y				Y			Y	Y				Y
Synthetic Rubber Gasket (IS : 11149)	Y	Y		Y	Y		Y							
LT SWITCHGEAR (IS : 8623)	Y	Y				Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes:

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

LT BUSDUCT

ATTRIBUTES , CHARACTERISTICS → / ITEM, COMPONENTS, SUB SYSTEM ASSEMBLY ↓	Dimension & Surface Finish	Make, Type, Rating & TC	Electrical Properties	Mechanical Properties	Chemical Properties	Item to conform to relevant IS	WPS Approval, Welder Qualification	Weld Quality Check (DP test & x-ray Test)	Paint Shade, Thickness, Adhesion & Finish	Tightness by Torque measurement	Electrical Clearances	Galvanizing Test as per IS 2629/ 2633/ 4759	IR – HV – IR Test	Phase Sequence Check	Degree of Protection routine test as per NTPC spec.
Aluminum Sheets / Plates / Strips / Flexibles / tubes (IS : 5082 / 737)	Y	Y		Y	Y	Y	Y	Y							
CRCA Flats / ISMC (IS 2062)	Y	Y		Y	Y	Y									
Neoprene / Synthetic Rubber Gaskets (IS 11149 / 3400)	Y	Y		Y	Y										
Rubber Bellows (IS : 3400)	Y	Y		Y	Y										
Support Insulator	Y	Y	Y	Y											
Galvanized Structure & GI Earthing Flat (IS : 2629 / 2633 / 4749)	Y	Y				Y						Y			
Space Heater & Thermostat		Y	Y										Y		
LT Busduct (IS : 8623 PART 2)	Y	Y				Y	Y	Y	Y	Y	Y		Y	Y	Y

Notes:

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

CONTROL AND INSTRUMENTATION FOR PLANT AUXILIARY SYSTEMS

PROGRAMMABLE LOGIC CONTROLLER

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 ® *	Test as per Std ® & (A)
1. PLC Panel	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2. Control Desk With PLC	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Note: 1) Detailed procedure of Environmental Stress Screening test shall be as per Quality Assurance Programme in General Technical Conditions

2) This is an indicative list of test/ checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and Procedure alongwith relevant supporting documents.

* Applicable for PLC Y - Test Applicable , ® - Routine Test (A) - Acceptance Test

ITEMS/COMPONENTS/ SUB-ASSEMBLY \ 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 Spec.
BATTARY 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 : 12021)	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 Environmental Stress Screening test shall be as per Quality Assurance Programme in General Technical Conditions
2. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the Practice and procedure along with relevant supporting documents.
3. Makes of all major Bought Out Items will be subject to NTPC approval.

POWER SUPPLY SYSTEM

ITEMS \ TEST	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 faliure 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 Environmental Stress Screening test shall be as per Quality Assurance Programme in General Technical Conditions

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.

ELECTRIC POWER SUPPLY SYSTEM

ATTRIBUTRES/ CHARACTERISTICS / ITEMS/COMPONENTS SUB-ASSEMBLY	Make, Model, Type, Rating & Finish	Chemical & Mechanical Tests	Sheet Steel Pretreatment & Painting process checks	Conform to relevant Standard	Dimensional check and Paint shade, thickness, adhesion & Finish checks	Complete physical examination for constructional features of Battery Charger as per NTPC specification	Temperature Rise Test	Dynamic Response Test	Ripple Content Test, Load Limiter & Annunciator & AVR Operation Test	Operational & Functional Checks	HV & IR Test	Burn-In Test at 50°C for 48 hrs	Degree of Protection Test as per NTPC Spec.
BATTARY 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 : 12021)	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 Enviromental Stress Screening test shall be as per Quality Assurance Programme in General Technical Conditions
2. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the Practice and procedure along with relevant supporting documents.
3. Makes of all major Bought Out Items will be subject to NTPC approval.

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 faliure and return test (R)	Parallel 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 Environmental Stress Screening test shall be as per Quality Assurance Programme in General Technical Conditions

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.

MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)

ITEMS \ TESTS	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Test as per standard (R)	Insulation Resistance (R)	IBR Certification (if applicable) (R)	Hydro Test (R)	Material Test certificate ®
1. PR Gauge (IS-3624)	Y	Y	Y	Y	Y				
2. Temp. Gauge (BS-5235)	Y	Y	Y	Y	Y				
3. Pr./D.P.Switch(BS-6134)	Y	Y	Y	Y	Y	Y			
4. Electronic Transmitter(IEC-770)	Y	Y	Y	Y	Y	Y			
5. Temp. Switch	Y	Y	Y	Y	Y	Y			
6. Recorder(IS-9319/ANSI C-39.4)	Y	Y	Y	Y	Y	Y			
7. Vertical indicators	Y	Y	Y	Y		Y			
8. Digital Indicators	Y	Y	Y	Y		Y			
9. Integrators	Y	Y	Y	Y					
10. Electrical Metering Instrument (IS-1248)	Y	Y	Y	Y	Y	Y			
11. Transducer (IEC-688)	Y	Y	Y	Y	Y	Y			
12. Thermocouples (ANSI-MC-96.1)	Y	Y	Y	Y	Y	Y			
13. RTD (IEC-751)	Y	Y	Y	Y	Y	Y			
14. Thermowell	Y		Y				Y	Y	Y

R-Routine Test A- Acceptance Test Y - Test applicable

Note: 1) Detailed procedure of Environmental Stress screening test shall be as per Quality Assurance Programme in General Technical Conditions

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.

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 Environmental Stress screening test shall be as per Quality Assurance Programme in General Technical Conditions

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.

ELECTRICAL ACTUATORS WITH INTEGRAL STARTER

ITEM/COPONENT/ SUB SYSTEM ASSEMBLY/TESTING / TEST/ATTRIBUTES CHARACTERISTICS	RPM ®	No Load Current ®	IR & HV Test®	Mounting Dimension®	All routine Test as per Standard & Specification®	Correct Phase Sequence®	Operation & Setting of limit Switch/Torque Switch®	Stall Torque/Current (A)	Hand Wheel operation/ Auto de clutch function (A)	Function of Aux. like Potentiometer, space heater, position indicator ®	EPT output ®	Grease leakage ®	Local/ Remote (Open-Stop-Close) Operation® Safety check (Single phasing, Phase correction, Tripping etc.) (A)
ELECTRICAL ACTUATOR WITH INTEGRAL STARTER(IS-9334)													
Motor	Y	Y	Y	Y	Y								
Final Testing	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Note: 1) Detailed procedure of Environmental Stress Screeing 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 along with relevant supporting documents.

® - Routine Test (A) - Acceptance Test Y - Test applicable

PROCESS CONNECTION AND PIPING

ITEMS \ TESTS	Visual ®	GA, BOM, Layout of component & construction feature®	Dimension ®	Paint Shade/thickness ®	Flattening, flaring, hydrotest, hardness check as per ASTM standard (A)	Component Ratings ®	Wiring ®	Make, Model, Type, Rating ®	IR & HV ®	Review of TC for instrument/devices (R)	Accessability of TBs/Devices ®	Illumination,grounding ®	Tubing ®	Leak/Hydro test (A)	Chemical/physical properties of material (A)	Proof pressure test, Dismantling & reassembly test, Hydrulic impulse and vibration test (R)	Tests as per standards & specification
Local Instrument enclosure	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y			
Local instruments racks	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y			
Junction Box	Y	Y	Y	Y*		Y		Y	Y								
Gauge Board	Y	Y	Y	Y		Y		Y		Y			Y	Y			
Impulse pipes and tubes	Y		Y		Y			Y							Y		
Socket weld fittings ANSI B-16.11	Y		Y					Y							Y		Y
Compression fittings	Y		Y					Y						Y	Y	Y	
Instrument valves & Valve manifolds	Y		Y					Y						Y	Y		
Copper tubings ASTM B75	Y							Y									Y

* - applicable for painted junction boxes.

Note: R-Routine Test A- Acceptance Test Y - Test applicable

Note: This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.

PEM :: C&I

STANDARD QUALITY PLAN FOR FLOW ORIFICE PLATE ASSEMBLY

QUALITY PLAN NO.:	**PE-QP-999-145-I024**
VOLUME	IIB
SECTION	D
REV. NO.	05 DATE: 30.05.13
SHEET	1 OF 2

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

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

PEM :: C&I

STANDARD QUALITY PLAN
FOR
FLOW ORIFICE PLATE ASSEMBLY

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

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

NOTE:

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

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

PEM :: C&I

STANDARD QUALITY PLAN FOR FLOW NOZZLE ASSEMBLY

QUALITY PLAN NO.:	**PE-QP-999-145-I005**
VOLUME	IIB
SECTION	D
REV. NO.	05 DATE: 30.05.13
SHEET	1 OF 3

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

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

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

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

PEM :: C&I

STANDARD QUALITY PLAN FOR FLOW NOZZLE ASSEMBLY

QUALITY PLAN NO.:	**PE-QP-999-145-I005**
VOLUME	IIB
SECTION	D
REV. NO.	05 DATE: 30.05.13
SHEET	3 OF 3

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

NOTE:

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

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
IR - Inspection Reports; TC - Test Certificates; AP – Approved Drawings/doc
DS – Data Sheet; SP – Tech. Spec.
MR- Manufacturer records; MS- Manufacturer standards
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1 - BHEL; 2 - Vendor; 3 - Sub-vendor

PEM :: C&I

STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)

QUALITY PLAN NO.:	**PE-QP-999-145-I 006**
VOLUME	IIB
SECTION	D
REV. NO.	06 DATE: 05.09.2013
SHEET	1 OF 7

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

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
RT- Radiographic Test; UT – Ultrasonic Test; PT – Dye penetrant Test; MT- Magnetic Test
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1 - BHEL; 2 - Vendor; 3 - Sub-vendor

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

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RT- Radiographic Test; UT – Ultrasonic Test; PT – Dye penetrant Test; MT- Magnetic Test
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1 - BHEL; 2 - Vendor; 3 - Sub-vendor

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
1.4	Electrical items [Limit switches, Solenoids, Position Transmitter(if provided externally)]	1. Routine Test	MA	HV, IR, Continuity function	100%	Rele. Standards	Rele. Standards	Test Certificate	3	---	2,1	In case TC is not available, Actual test shall be conducted
		2. Degree of protection	MA	IP/NEMA Tests	One sample / type	Approved Data sheet	Approved Data sheet	Test Certificate	3	---	2,1	
1.5	Pressure Gauges	1. Performance	MA	Review of calibration certificates	100%	Mfr. Standard	Mfr. Standard	Test Certificate	3	---	2,1	
		2. Marking	MA	Visual	100%	Mfr. standard	Mfr. standard	Records	3	---	2,1	
2.0	**IN PROCESS INSPECTION**											
2.1	After machining, i, Body ii Bonnet iii Plug iv Valve Stem v seat ring/cage	1. Surface flaws	MA	Visual & MT/PT	100% (on accessible surfaces)	ASME B 16.34	ASME B 16.34	Test Records	2	---	1	Butt weld ends shall be included.
		2. Dimensional checks	MA	Measurement	100%	Mfr. Standard	Mfr. Standard	Records	2	---	1	
		3. Hard facing (wherever applicable)	MA	Hardness Measurement	One sample/Lot	Mfr. Standard	Mfr. Standard	Records	2	---	1	
2.2	Lapping	Machining surface contact	MA	Blue Matching	One sample/lot	------	Proper Physical Contact	---	2	---	---	
3.0	**TESTS ON COMPLETED VALVE**											

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1 - BHEL; 2 - Vendor; 3 - Sub-vendor

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

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
RT- Radiographic Test; UT – Ultrasonic Test; PT – Dye penetrant Test; MT- Magnetic Test
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1 - BHEL; 2 - Vendor; 3 - Sub-vendor

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

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

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RT- Radiographic Test; UT – Ultrasonic Test; PT – Dye penetrant Test; MT- Magnetic Test
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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	

NOTES:

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

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RT- Radiographic Test; UT – Ultrasonic Test
PT – Dye penetrant Test; MT- Magnetic Test
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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	1 OF 7

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

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

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

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PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	3 OF 7

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

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

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	4 OF 7

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

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1 - BHEL 2 - Vendor 3 - Sub-vendor

PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	5 OF 7

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

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	6 OF 7

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

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

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PEM :: C&I

STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER

QUALITY PLAN NO.: **PE-QP-999-145-I036___**

VOLUME IIB

SECTION D

REV. NO. 01 DATE: 24.08.2007

SHEET 1 OF 8

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
1.0	**Materials /Components**											
1.1	Panels & Control Desks	Physical Inspection for Dimensions, Painting, Cutouts, Lifting / Locking Arrangements, Components, Drawing Pocket, Mounting accessories, Plinth & AV Pads, Cable Gland Plates, Hardwares, Hinges, Louvers & Filters, Fans & Panel Lamps	MA	Visual	100%	Contract specifications, Approved GA Drawings, BOQ	As per ref documents. No physical damage.	BHEL Quality Inspection Report.	3/2	2	1	
1.2	Power Supply/Packs, Battery & Battery charger, Transformer, UPS.	Physical Inspection Physical Damages Dimensions Mounting Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per reference documents, Test Report	BHEL Quality Inspection Report.	3/2	2	1	
1.3	Indicating Lamp, Annunciator, Meters, Transducers, Signal Converters, Instruments, Single Loop Controllers	Physical Verification Physical Damages Dimensions Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per ref documents No physical damage. Test/ Calibration report.	BHEL Quality Inspection Report	3/2	2	1	
1.4	PLC processors, I/O modules, Power Supply modules, Communication modules, Mounting Racks, Ethernet	Physical Inspection • Identification Labels • Physical Damages • Quantity • Spare Capacity	MA	Visual	100%	Product Catalogue, Data sheets, Approved Configuration diagram, BOQ	As per ref documents. Test Certificates	BHEL Quality Inspection Report.	3/2	2	1	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
1.5	CPU, Monitor, Keyboard, Mouse, CD Drives, Printers, OS, System Software, Engineering software in the form of Licensed CD.	Physical Inspection Identification Labels, Tech. Specification Physical Damages Accessories Installation arrangements for Computers & Printers	MA	Visual	100%	Contract specifications, Product Catalogue, Approved GA / Configuration drawing, BOQ.	As per reference documents.	BHEL Quality Inspection Report.	3/2	2	1	

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

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

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FACTORY ACCEPTANCE TEST (FAT) PROCEDURE

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

a) Technical Specification of PLC.

b) PLC System Configuration

c) General Assembly Drawings.

d) Panel Wiring Diagrams.

e) Bill of Quantity for PLC System.

f) Logic Diagram.

g) HMI Schematics.

h) Input / Output List.

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

APPLICABLE TEST PROCEDURE:

1. Input/Output Functional Verification.

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

2. Processor Verification

PLC Configuration drawing to be referred for ascertaining

i) Redundancy

ii) Type (Hot or Cold)

Both the processors are to be checked for healthiness in case of redundant configuration as per vendor's standard practice. In case of hot redundancy, switchover of control from primary processor to standby processor shall be demonstrated for uninterrupted control and data processing as per vendor's standard practice. Switchover shall be witnessed, by manual power off or resetting the Primary CPU or simulating failure of primary processor. Checking should be by witnessing the lighting up of Processor's LEDs as per manufacturer's product standard.
Vendor shall demonstrate, as per Vendor's standard practice, adequate Loading (Spare Capacity) of Processors, as mentioned in contract specs. This shall be done, by simulating worst load operation of fully integrated PLC system.

3. Power Supply Module Verification

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

4. Communication System Verification

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

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

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

5. Diagnostic Verification

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

6. Control Panel /Desk Verification

i) PLC driven annunciation system should be checked by alarm signal simulation.

ii) Push Button and selector switch operation should be checked by verification of corresponding change of status of Data Base point.

iii) Indicating lamp / MIMIC should be checked by corresponding Data Base point simulation.

7. Software Verification

i). Control Logics:– Software switches, lamps and Analog sources shall be used for simulation of field conditions .Control logics shall be checked for its correct functionality as per approved logic schemes

ii). Engineering features:-
a) Online changing of parameters, set points.
b) Online modification in Control Logic Diagrams.
c) Online configuration of Graphics, Trends, Logs, HSR.

iii). HMI features:-
Check for configuration & operation of Graphics, Trends, Logs, HSR and Alarms, in the form of Displays and Printouts, by simulation of Inputs as per approved documents.

8. Burn in Elevated Temperature test

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

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

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

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

LIST OF SUB-VENDORS

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

Annuciator/Control panel (refer note 4)	Internationally reputed make as per choice of Approvedmain supplier.
Solenoid valves	Asco,USA/ IMI Norgen Germany
Vacuum pump	Acmevac Sales Pvt. Ltd, Mumbai, India /NI Tech USA & S.Africa/Edwards Limited, UK/Gardner Denver Nash, China/Dicon, Mumbai Reputed
Hydrogen Dryer	Mellcon ENGS> PVT. LTD, New Delhi/Jindal Elect, Rourkee.
Cylinder test station	Indian compressors Limited, New Delhi, India/ Reputed
Hydrogen Filling Manifold	Misatu Weldquip Pvt. Ltd., Gujarat / Reputed
Nitrogen Manifold	Misatu Weldquip Pvt. Ltd., Gujarat / Reputed
N2 / H2 Cylinders	BPCL Allahabad India/ Everest Kanto Cylinder Ltd. India
Ventilation Equipment	khaitan / Flakt / CBDoctor / Marathon/ Kruger/Nicotra
Zenner Barrier	MTL / P+ F India / Reputed
Instrument Cable	Delton cables,Faridabad/paramountcables, Hhushkhera/ Reliance, banglore/Polycab, Daman/ Universal Cables, Satna/ Elkay Telelinks, New Delhi/ Cords, Bhiwadi.
415 V LT Switch gear	C&S, Noida/ Seimens LTD. Mumbai/Alstom LTD, Kolkatta/L&T Coimbatore or Munbai/ GE Indai, Banglore/ Schneider Electric India Pvt Ltd, Nasik.
Flame proof motors	KEC,_Hubli/CGL,_Ahmednagar/_Bharat_Bijli,_ Mumbai_

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

Pressure Transducer	Barksdale, USA/Camille Bauer, Switzerland/ Metrawatt, Germany
Valves Gate, Globe, Check (15 NB to 250 NB) (up to 2500 Class)	TOA Valves, Japan/ Deutsche Babcock, Germany/ Dresser, USA
Valves Gate, Globe, NRV (15 NB to 250 NB) (up to 800 Class)	Audco, Chennai/ BDK, Hubli
Check valves	NUPRO, USA
Level Transmitter (Displacer type)	Dresser Mesonelan, France/ Yamatake Honeywell/ Japan, ECKORDT, Germany/ Dresser, USA
Level Transmitter (Capacitance type)	Magnetrol, Belgium/ E&H, Germany
Pressure Gauges	Swagelok, USA/Alecandria WIKA, Germany/ Dresser Aschcroft, USA/ Budenburg, UK
Pressure switches, Temperature switch, DPS	NEODYN, USA/Delta, UK/ ITT Barton,USA/ KDG, UK/ Dresser,USA/ SOR, USA/Herion, Germany
Differential pressure Indicators	ITT Baron, USA/Budenburg, UK/ Switzer/ Dresser Asherroft,USA
Computers	DELL/COMPAQ/HP/LENOVO
Printers	HP/CANON/Xerox/SAMSUNG
Air Conditioner	Carrier/LG/HITACHI/BLUE STAR (Minimum 4 star BEE rated Split AC reqd.)
Ventilation Fans	Marathon Electric/Khatan/ABB/Alstom/Bajaj

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

PAINTING SCHEME DETAILS

15.00.00 **SPECIFICATION FOR SURFACE PREPARATION & PAINTING**

15.01.00 Surface preparation methods and paint/primer materials shall be of the type specified herein. If the contractor desires to use any paint/primer materials other than that specified, specific approval shall be obtained by the contractor in writing from the employer for using the substitute material.

15.02.00 All paints shall be delivered to job site in manufacturers sealed containers. Each container shall be labeled by the manufacturer with the manuacturer's name, type of paint, batch number and colour.

15.03.00 Unless specified otherwise, paint shall not be applied to surfaces of insulation, surfaces of stainless steel/nickel/ copper/brass/ monel/ aluminum/ hastelloy/lead/ galvanized steel items, valve stem, pump rods, shafts, gauges, bearing and contact surfaces, lined or clad surfaces.

15.04.00 All pipelines shall be Colour coded for identification as per the NTPC Colour-coding scheme, which will be furnished to the contractor during detailed engineering..

15.05.00 **SURFACE PREPARATION**

15.05.01 All surfaces to be painted shall be thoroughly cleaned of oil, grease and other foreign matter. Surfaces shall be free of moisture and contamination from chemicals and solvents.

15.05.02 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.

SP1 Solvent cleaning

SP2 Application of rust converter (Ruskil or equivalent grade)

SP3 Power tool cleaning

SP4 Shot blasting (shot blasting shall be used as surface preparation method for hot worked pipes prior to application of primer)

SP4* Shot blast cleaning/ abrasive blast cleaning to SA21/2 (near white metal) 35-50 microns

SP5 Phosphating

SP6 Emery sheet cleaning/Manual wire brush cleaning.

15.06.00	**APPLICATION OF PRIMER/PAINT**
15.06.01	The paint/primer manufacturer's instructions covering thinning, mixing, method of application, handling and drying time shall be strictly followed and considered as part of this specification. The Dry film thickness (DFT) of primer/paint shall be as specified herein.
15.06.02	Surfaces prepared as per the surface preparation scheme indicated herein shall be applied with primer paint within 6 hours after preparation of surfaces.
15.06.03	Where primer coat has been applied in the shop, the primer coat shall be carefully examined, cleaned and spot primed with one coat of the primer before applying intermediate and finish coats. When the primer coat has not been applied in the shop, primer coat shall be applied by brushing, rolling or spraying on the same day as the surface is prepared. Primer coat shall be applied prior to intermediate and finish coats.
15.06.04	Steel surfaces that will be concealed by building walls shall be primed and finish painted before the floor is erected. Tops of structural steel members that will be covered by grating shall be primed and finish painted before the grating is permanently secured.
15.06.05	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 400 ^{o}C - 600 ^{o}C) , IS-13183 Gr.-II (for temperature 200 ^{o}C - 400 ^{o}C) and IS-13183 Gr.-III (for temperature upto 200 ^{o}C) PS13- Rust preventive fluid by spray, dip or brush. PS14- Weldable primer-Deoxaluminate or equivalent.

CLAUSE NO.	TECHNICAL REQUIREMENTS
	PS16- High Build Epoxy CDC mastic `15' . PS17- Aliphatic Acrylic Polyurethane CDE134 ,%V=40.0(min.) PS18- Epoxy based TiO2 pigmented coat PS19- Epoxy based Zinc phosphate primer (92% zinc in dry film (min.), %VS=35.0(min.). PS20- Epoxy based finish paint.
15.06.06	All weld edge preparation for site welding shall be applied with one coat of weldable primer.
15.06.07	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.

15.07.00 Primer/Painting Schedule

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

4.	**Valves**												
	Cast /Forged	Design temperature <60 ^{o}C	SP1/SP2/ SP3	PS4/PS 9	1	40	Polyamide Epoxy	1	100	PS17	1	40	180
		Design temperature 60 ^{o}C-200 ^{o}C	SP1/SP2/ SP3	PS 9*	1	20	-	-	-	PS9*	1	20	40
		Design temperature > 200 ^{o}C	SP1/SP2/ SP3	PS9*	1	20				PS9*	1	20	40
5.	All Structural Steel components	Outside TG building and in SG envelope	SP4*	Inorganic Ethyl Zinc Silicate	1	75	PS18	1	75	a))Epoxy coat b)Final coat of paint PS17	2 1	35 30	250
		Within TG building	SP4*	-do-	1	35	PS18	1	35	a))Epoxy coat b)Final coat of paint PS17	2 1	25 30	150

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

17.00.00 Testing Requirements:

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

DRAWING /DOCUMENT DISTRIBUTION SCHEDULE

DRAWING /DOCUMENT DISTRIBUTION SCHEDULE.

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

LIST OF DOCUMENT TO BE SUBMITTED

LIST OF DOCUMENT TO BE SUBMITTED AFTER LOI

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

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

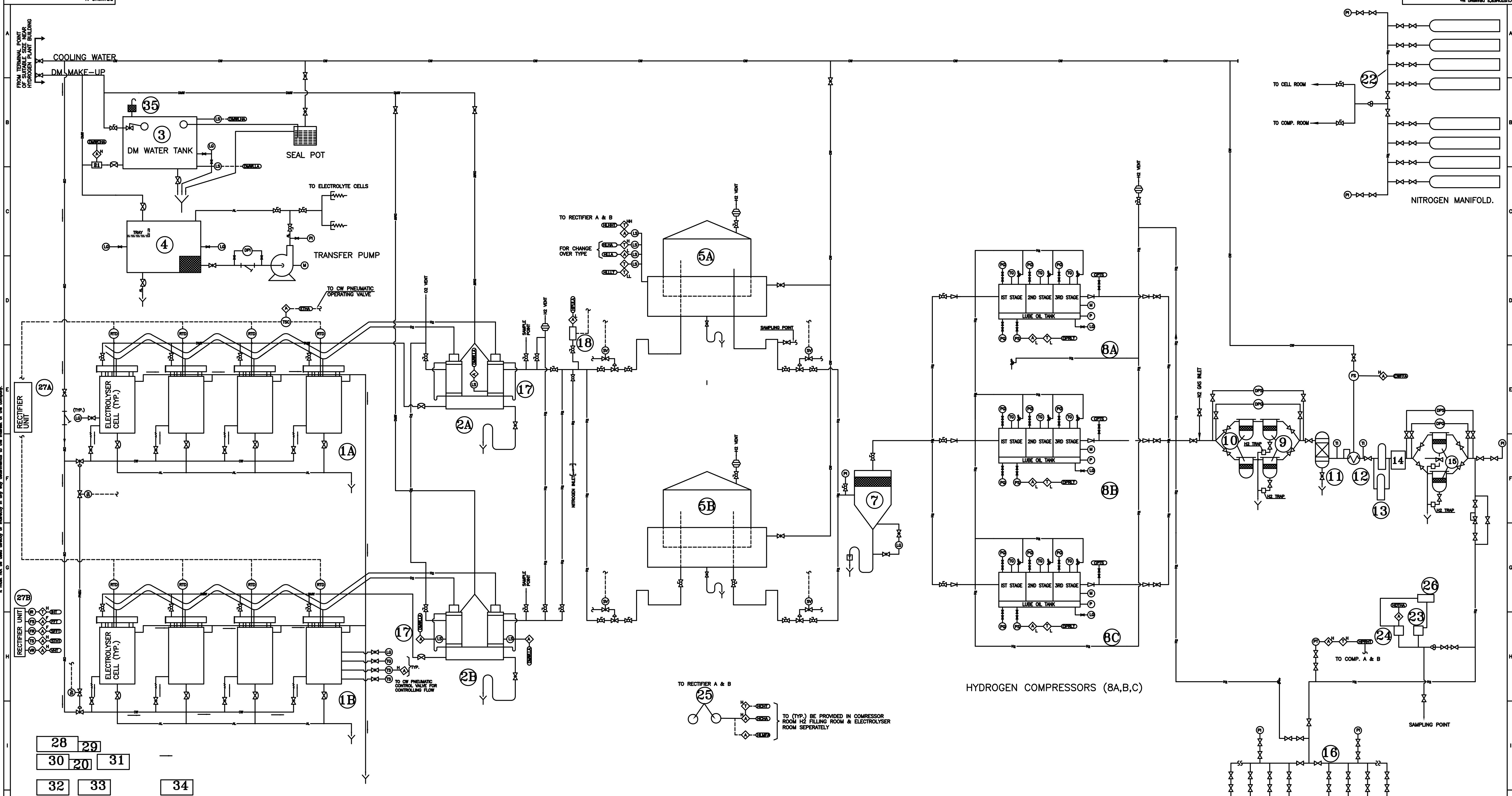
Bidder to note that BHEL reserve the right for drawing/document submission through web based Document Management System (DMS). Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder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

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

P & I DIAGRAM

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM



NOTES

1. THIS P&ID IS TYPICAL FOR UNIPOLAR SYSTEM. P&ID CAN BE DIFFRENT FOR BIPOLAR SYSTEM.
2. ANY OTHER INSTRUMENT & DEVICES REQUIRED FOR EFFICIENT & SAFE OPERATION OF PLANT SHALL BE SUPPLIED.
3. NO. OF STAGES IN COMPRESSOR SHALL BE AS PER INLET/OUTLET PRESSURE REQUIREMENT AS PER MANUFACTURERS PRACTICE /PROCESS.
4. GAS HOLDERS ARE APPLICABLE FOR UNIPOLAR ONLY.
5. RELATIVE SEQUENCE OF GAS HOLDERS,PURIFIERS,COMPRESSORS TO SUIT MANUFACTURERS PROCESS DESIGN.
6. NO. OF ELECTROLYSER CELLS/MODULES PER STREAM TO SUIT MANUFACTURERS PROCESS DESIGN.
7. REQUIREMENT OF GAS WASHING TANK/MIST ELIMINATES/KNOCK OUT DRUMS ETC. SHALL BE AS PER MANUFACTURERS DESIGN.
8. IN CASE OF BIPOLAR DESIGN, GAS PURIFYING SYSTEM MAY BE PART OF ELECTROLYSRER MODULE. AS PER MANUFACTURERS DESIGN.

LEGEND & MINOR INSTRUMENT LIST

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
		DMWLLA	DM WATER LOW LEVEL ALARM-II GAS WASHING TANK/DM WATER TANK	HPRLA	H2 PRESSURE LOW ALARM
		OPRLT	LUBE OIL PRESSURE TRIP-COMPRESSOR	CPTS	COMMON PRESSURE PUMP SWITCH-COMPRESSOR
	CONDENSATE TRAP	CWFFA	COOLING WATER FLOW FAILURE ALARM	DMWLHA	DM WATER LEVEL HIGH ALARM
	PUMP	HSFHA	H2 SUCTION FILTER DIFFERENTIAL HIGH ALARM	HPULA	H2 PURITY LOW ALARM-TRACE O2 ANLYSER
	MOTOR	TSC	TEMPERATURE SCANNER	HCHA	H2 CONCENTRATION HIGH ALARM
	DRAIN	SFFT	THYRISTOR FUSE FAIL TRIP (RECTIFIER)	ETHA	ELCTROLYSE TEMP. HIGH ALARM
	FLAME ARRESTOR	STHT	RECTIFIER SINK TEMP HIGH TRIP (RECTIFIER)	HLLA	H2 LEVEL LOW ALARM
	STRAINER	VHT	DC OVER VOLTAGE TRIP (RECTIFIER)	DMWCHA	DM WATER CONDUCTIVITY HIGH ALARM
	SOLINOID VALVE	IHT	DC OVER CURENT TRIP (RECTIFIER)	HTHA	H2 TEMP HIGH ALARM
	BACK PRESSURE VALVE	FS	FLOW SWITCH	HPRHT	H2 PRESSURE HIGH TRIP COMPRESSOR
	SAFETY VALVE	DPI	DIFFERENT PRESSURE INDICATOR	LS	LEVEL SWITCH/LIMIT SWICTH
	FLOAT VALVE	DPS	DIFFERENT PRESSURE SWITCH	LG	LEVEL GAUGE
	PNEUMATIC OPERATED VALVE	FFT	COOLING FAN FAIL TRIP (RECTIFIER)	TIS	TEMP INDICATOR SWITCH
	NON-RETURN VALVE	RTD	RESISTANCE TEMP DETECTOR	HLLLT	H2 LEVEL LOW LOW TRIP (COMPR.)
	NEEDLE VALVE	HLMFA	H2 LEAKAGE MONITOR FAULT ALARM	HLHHT	H2 LEVEL HIGH HIGH TRIP (RECTIFIER)
	DIAPHRAGM VALVE	PRS	PRESSURE REDUCING STATION	PS	PRESSURE SWITCH
	BALL VALVE	HCHT	H2 CONCENTRATION HIGH TRIP	PI	PRESSURE INDICATOR
	GLOBE VALVE	HDTHA	H2 DEW POINT TEMP HIGH ALARM	HLHA	H2 LEVEL HIGH ALARM
	GATE VALVE		ADJUSTABLE THROTTLE	TI	TEMP INDICATOR

EQUIPMENT & INSTRUMENT LIST

S.NO.	DESCRIPTION	QTY.	S.NO.		QTY.
19	SUCTION FILTER	2			
18	% OXYGEN /TRACE O2 ANALYSER (L.P. SIDE)	1			
17	MANOMETER	8			
16	HYD. GAS MANIFOLD (2X4 CYL.)	1SET			
15	DUST FILTER	2	35	CO2 ABSORBER	1
14	DRIER (DUAL TOWER)	1	34	MCC	1
13	COALESCING FILTER	2	33	ORSAT ANALYSER	1
12	AFTER COOLER CUM SEPERATOR	1	32	PORTABLE SPECIFIC GRAVITY MEASURING INSTRUMENT	2
11	DE- OXY PURIFIER	1	31	PORTABLE TRACE OXYGEN ANALYSER	1
10	OIL ABSORBER FILTER	2	30	H2 CYL. TESTING APPARTUS	1
9	PRE FILTER	2	29	ISI/ZENER BARRIER PANEL	1
8A,B,C	HYD. COMP. WITH NON SPARKING TYPE MOTORS	3	28	CONTROL PANEL	1
7	KNOCK OUT DRUM FOR HYD.	2	27A,B	RECTIFIER UNIT	2
		2	26	MULTI PEN RECORDER	1
		2	25	H2 LEAK DETECTION SYSTEM	LOT
5A,B	GAS HOLDER FOR HYD.	2	24	MOISTURE ANALYSER (DEW POINT METER)	1
4	ELECTROLYTE PREP. TANK & TRANSFER PUMP	1	23	TRACE OXYGEN ANALYSER (H.P. SIDE)	1
3	D.M .WATER TANK	1	22	N2 PURGING SYSTEM (2X4 CTL.)	1SET
2A,B	GAS WASHING TANK	2	21	D.M. WATER CONDUCTIVITY METER	1
1A,B	ELECTROLYSER CELLS	AS REQD.	20	VACUUM PUMP	1

SYMBOL	LEGEND
AL	ALKALI LINE
O_2	OXYGEN LINE
- - - - -	ELECTRICAL LINE
CW	COOLING WATER LINE
N_2	NITROGEN LINE
H_2	HYDROGEN LINE

PE-DG-394-168-A001

JOB No. : 390

STATUS: CONTRACT

DISTRIBUTION

TO	No.OFF	REV	DATE	ALTD	CHD	APPD

OWNER: NATIONAL THERMAL POWER CORPORATION LTD.(NTPC)

PROJECT

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI

DEPT CODE		NAME	SIGN	DATE
M	DRN	FS		
	DESN	FS		
	CHD	FS		
	APPD	SB		

TITLE: P&I DIAGRAM FOR HYDROGEN GENERATION PLANT

DEPT. SCALE DRAWING No.

SIGN DATE SHEET OF REV-0

SIZE-A2

LIST OF MANDATORY SPARES

CLAUSE NO.	MANDATORY SPARES

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

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

CLAUSE NO.	MANDATORY SPARES	

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

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

CLAUSE NO.	MANDATORY SPARES	

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

GUARANTEED POWER CONSUMPTION

GUARANTEED POWER CONSUMPTION

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

INFORMATION TO BE FURNISHED BY THE BIDDER ALONG WITH BID

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

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

6. Duly signed and stamped Guaranteed Performance Data

HYDROGEN GENERATION PLANT

Clause No.	BIDDER'S NAME.....	
	HYDROGEN GENERATION PLANT	
1.00.00	**TYPE OF PLANT**	Unit Polor / Biplor 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 Explo-sives Authority of India?**	Yes/No
1.04.00	Whether the plant is designed for : –	
	i) Continuous duty ?	Yes/No
	ii) Parallel operation of streams ?	Yes/No
	iii) Operation of electrolyser in part Load ?	Yes/No
	iv) Operation from the control panel ?	Yes/No
	v) Flexibility of isolating of any cell of electrolyser and operation for rest of the streams ?	Yes/No
	vi) Automatic operation of standby compressors?	Yes/No
	vii) Automatic change over of gas holders ?	Yes/No

Clause No.	BIDDER'S NAME.....	
1.05.00	Whether complete instrumentation and control system provided as specified	Yes/No
1.06.00	Whether complete ventilation system as provided for no. of plants as specified	Yes/No
2.00.00	**EQUIPMENTS**	
	A) Rectifiers	
	i) Make & Model No. of rectifier	.....
	ii) Type of rectifier	.....
	iii) Rating in (KW)	.....
	B) Electrolysers	
	i) Manufacturer	.....
	ii) Capacity of the electrolyser in (Nm^3/hr) (Rated)	.....
	iii) Pressure of hydrogen gas generated (Kg/cm^2 (g))	.....
	iv) Temperature of hydrogen gas generated	.....
	v) Consumption of electricity in KW/NM^3 of H_2	.....
	C) Gas holders of Hydrogen and Oxygen	**Hydrogen** **Oxygen**
	i) No. of gas holders offered	....
	ii) Capacity and size of each gas holder (m^3)	....

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

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

LT SWITCHGEAR

.....
(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 (Shall be as per approved QA make)	.....
1.02.00	Equipment driven by motor	.....
1.03.00	Motor type	.....
1.04.00	Quantity	.....
2.00.00	**DESIGN AND PERFORMANCE DATA**	
2.01.00	Frame size	.....
2.02.00	Type of duty	.....
2.03.00	Type of enclosure and method of cooling, Degree of protection	.....
2.04.00	Applicable standard to which motor generally conforms	.....
2.05.00	Type of mounting	.....
2.06.00	Direction of rotation as viewed from DE END	.....
2.07.00	Standard continuous rating at 40 deg.C. ambient temp. (KW)	.....
2.08.00	De rated rating for specified normal condition i.e. 50 deg.C ambient temperature (KW)	.....
2.09.00	Rated Voltage (volts)	.....
2.10.00	Permissible % variation of	
	a) Voltage (Volts)	.....
	b) Frequency (Hz)	.....
	c) Combined voltage and frequency	.....

		..... (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	.....
	b. With driven equipment coupled	.....

Clause No.	MOTORS	
		..... (Bidder's Name)
2.18.00	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	.....
	c. Self Lubricated or forced Lubricated	.....

.....
(Bidder's Name)

	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)	.....
	d. Method of temperature measurement	.....

		..... (Bidder's Name)
	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	.....
	g. Lubrication type	.....

		..... (Bidder's Name)
	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)	.....
	b) 1.2/50 micro sec surge (KVp)	.....

.....
(Bidder's Name)

3.12.00	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)	.....

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-Vk (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 Votlage	.....
j)	Rotor Terminal Box		.....
k)	TBs for RTDs. BTDs & Space Heater (Yes/No)		.....

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	.....
	x) Any other fitments	.....

.....
(Bidder's Name)

5.00.00	**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)	.....
6.06.00	Full load Field current (Amp)	.....

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

.....
(Bidder's Name)

6.15.00	GA drawing of motor	.....
6.16.00	Starting time calculation	.....
6.17.00	Starter resistance design calculation	.....
6.18.00	Electrical connection diagram of motor	.....

POWER AND CONTROL CABLES

.....
(Bidder's Name)

POWER AND CONTROL CABLES
(Use separate sheet for each type and size of cables)

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

		..... (Bidder's Name)	
	c) Shape of conductor	.....	.....
	d) DC resistance at 20°C (Maxm.)	.....	.....
1.11.00	Insulation		
	a) Material	.....	.....
	b) Nominal thickness (in mm)	.....	.....
	c) Type of curing (for XLPE)	.....	.....
1.12.00	Metallic screen (wherever applicable)		
	a) Material	.....	.....
	b) Type	.....	.....
	c) Short Ckt. (KA) & Period (Sec.)		
1.13.00	Material & Type of Inner sheath	.....	.....
1.14.00	Armour material & shape	.....	.....
1.15.00	Outer sheath material & type	.....	.....
1.16.00	Over all dia of cable (in mm)	.....	.....
1.17.00	Guaranteed value of minimum oxygen index of outer sheath	.....	.....
1.18.00	Maximum acid-gas generation by weight (%) of outer sheath	.....	.....
1.19.00	Smoke Density rating of outer sheath	.....	.....

CABLING EARTHING AND LIGHTNING PROECTION