BHARTIYA RAIL BIJLEE COMPANY LTD.

4X250 MW, NABINAGAR THERMAL POWER PLANT

TECHNICAL SPECIFICATION
FOR
HYDROGEN GENERATION PLANT

SPECIFICATION NO: PE-TS-300-168-A000
VOLUME -IIB & III

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

SECTION - A
SCOPE OF ENQUIRY

1.0 SCOPE OF ENQUIRY

This specification is intended to cover design, engineering, manufacture, inspection, testing at manufacturer's works, supply/delivery duly packed at site including freight, unloading, storage and handling at site, erection and commissioning, trial run at site, 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 **4X250 MW, NABINAGAR THERMAL POWER PLANT**

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

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

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

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

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

1.7 In case of any data/requirement stipulated in the drawings but not in the specification and vise-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

CLAUSE NO.	PROJECT INFORMATION

Project Synopsis

1.00.00 BACKGROUND

Details of proposed Stage / Units

Project name	:	Nabinagar Thermal Power Project
No. of Units x capacity	:	4 x 250 MW
Project setting up by	:	Bhartiya Rail Bijlee Company Ltd. (A Joint Venture Company between NTPC Ltd. & Indian Railways)

2.00.00 LOCATION AND APPROACH

Project Location	: (i.) Place : Nabinagar : (ii) District :Aurangabad : (iii.) State :Bihar
Latitude and Longitude of project location	: North :24 deg.42' 30" (N) East :84 deg. 05' 36" (E)
Nearest Railway station	: Dehri-On-Sone
Distance of project location from the Railway station	: 30 KM (Approx.)
Nearest Major Town	: Aurangabad
Distance of the town from the Project site	: 50 KM
Nearest Commercial Airport	: Gaya
Distance of airport from the project site	: 100KM
Nearest Highway	: National Highway - 2
Distance from nearest highway point to the site	: 25KM
Vicinity plan	: Vicinity plan of the project enclosed
Any other information:	: Further to the informations given in this sub-section , Bidders are advised to visit the project site and collect data on local site conditions

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

CLAUSE NO.	PROJECT INFORMATION
5.00.00	**RAILWAY SIDING**
	For bringing the equipment and material to the power house through rail, railway siding is proposed to be constructed from nearest railway station.
6.00.00	**METEOROLOGICAL DATA**
	Meteorological data of the nearest observatory Dehri station is enclosed as Annexure-II to this subsection.
7.00.00	**PLANT WATER SCHEME**
	The plant water scheme shall be referred in the relevant Tender Drawings.
7.01.00	**Condenser Cooling (CW) Water System**
	It is proposed to provide recirculating type CW system with induced draft type cooling towers.
7.02.00	**Equipment Cooling Water (ECW) System (Unit & Station Auxiliaries)**
	For scheme of Equipment Cooling Water System refer relevant tender drawings.
8.00.00	**ASH WATER SYSTEM**
	It is proposed to provide ash water re-circulation system. Decanted water from ash pond shall be led to the plant area by using pumps and the same shall be conveyed through carbon steel pipes from ash dyke to plant area. . This water will be used further in the ash handling system. Blow down of ash water from the system shall be carried out to maintain the system scale free Normal make up to the ash water system shall be from CW blow down water. However provision shall also be kept for operating ash water system on "Once Through" mode During "Once Through" mode operation, additional makeup shall be met from the plant raw water supply. Provision to supply treated plant effluent from central monitoring basin to ash handling shall also be kept.
9.00.00	**OTHER MISCELLANEOUS WATER SYSTEMS**
	The quality of Clarified water filtered (potable) water and DM water is given in the enclosed Annexure-I to this Sub-section.
10.00.00	**CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT**
	All structures and equipment of the power plant, including plant auxiliary structures and equipment, shall be designed for wind forces as given in the Technical Specification on Civil Works.
11.00.00	**CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT**
	All power plant structures and equipment, including plant auxiliary structures and equipment shall be designed for seismic forces as given in the Technical Specification on Civil Works.

SECTION – C

SPECIFIC TECHNICAL REQUIREMENT

SECTION – C1

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

GENERAL:-

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

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

A) Major Mechanical scope:-

1. Two streams of electrolysers working in parallel (each of capacity minimum 4.5 Nm3/hr.).
2. Three (3) numbers of hydrogen gas compressors and drives (each of minimum 5.6 Nm3/hr.) with cell purging system, mixing tank, DM tank, pumps to handle electrolyte and its filters, gas washing system, two gas holders each of minimum capacity 10 m3 for unipolar desgn.
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:**
   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 Service Water analysis is attached with this technical specification as Annexure 3 section C1. If the bidder finds the analysis of service 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 NTPC shall be arranged by bidder.
11. Bidder shall include in his scope one lot of mandatory spares as per list enclosed as section C1 of technical specification.
12. 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.
13. 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. The instrumentation shown in P&ID is bare minimum and are in bidder's scope.
2. The control of hydrogen generation plant shall be dual processor based PLC system, PLC unit shall be provided with two processors (main processing unit with memories) one for normal operation and one as cold standby.
3. The PLC system shall be provided with necessary interface hardware and software 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 either net link following TCP / IP standard. The system shall be OPC compliant. The dual fiber optic communication cable between bidders control panels and employer's DDCMIS is included in bidder's scope. Bidder shall include accessories required at PLC end for connectivity to other systems. Supply of hardware, communication cables and software required for establishing Fiber optic link between PLC & DDCMIS inclusive of Fiber optic cable (Approx. 1000 M), LIU (Light interface unit) are under Vendor Scope. Further Signal mapping and commissioning support for establishing communication with DDCMIS is also under Vendor Scope. The other control and instrumentation design requirement shall be as specified in section D3 of technical specification.

D**) Civil scope:-**

1. **All civil works including building & foundation of equipment are excluded from bidder's scope.** However, bidders to note that complete grouting of the equipment, fixing etc. shall be in the scope of bidder.
2. Bidder shall also include in their scope U clamp, nut, bolt etc, required for piping on pedestal/channel. Further channel for piping shall also be in bidders scope. 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 inline 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 that all the sub-vendors shall be in line with the sub vendor list attached in section C1.The sub vendor list enclosed is indicative only and is subjected to approval/acceptance by customer. Bidder to propose his sub vendor list with back up documents (credentials) etc. The same shall be subjected to BHEL and customer approval during detail engineering stage without any commercial & delivery implication to BHEL.

I) **DEMOSTRATION TEST:-**

Bidder shall demonstrate the guarantee parameters as per the section D1 of technical specification requirement to the satisfaction of Owner. The exact modalities of verifying guarantee for the parameters indicated in the specification shall be finally as agreed with the Owner during detailed engineering & mutually agreed.
The Bidder shall arrange all the monitoring gadgets / instruments / equipment required for performing guarantee parameters (returnable after test). Site facility as available or as extended by Owner shall only be provided.

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

TP1:- Cooling water (Refer annexure – 3, section C1 for the feed water analysis):- 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. If the

bidder finds the analysis of service 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.

TP2, 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.

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

TP3 :- 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 C4 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 in 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, Demonstration 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:-**

S. No	Description	Nabinagar
1	Rate of loading during evaluation	US $ 2129
2	Rate of penalty during PG test	US $ 2129

Note 1: - Bidder to note that 1/3 (33%) of power consumption quoted by bidder (power consumption for electrolyser and compressor of one stream of the hydrogen generation plant) shall be used for evaluation and penalty purpose.
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.
Note-3:- Evaluation shall be done w.r.t the base power consumption of 40 KW, (Total power consumption of one stream). 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.
(Total Power consumption of one stream quoted by the bidder-40)/3*US$ 2129.
Note-4:- 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 by 1/3 of per increases in KW, power consumption shall be levied.

M) BUILDING LAYOUT FOR HYDROGEN GENERATION PLANT

Bidder to refer layout for Hydrogen Generation Plant for both Bipolar or Unipolar technology enclosed in section C1. Bidder to confirm that the space provided for Hydrogen Generation Plant building is sufficient for the plant offered for this project and all the equipment shall be erected by bidder in the space provided. However, minor variation in building size is acceptable during detail engineering.

ANNEXURE - 1

ANALYSIS OF DM WATER TO BE USED

SL. NO.	Charachteristics	Value
1	Silica (Max)	0.02 ppm as SiO2
2	Iron as Fe	Nil
3	Total hardness	Nil
4	Ph value	6.8 to 7.2
5	Conductivity excluding the effects of free CO2 (Micro-mho/cm)	Not more than 0.1

ANNEXURE – 2

GUARANTEED PERFORMANCE DATA

SL. NO.	Description	Parameters
1	Hydrogen generation plant minimum capacity (Nm3/hr.)	9
2	Number of streams	2
3	Minimum Capacity of each streams (Nm3/hr.)	4.5
4	Hydrogen purity (%) at gas manifolds	99.9
5	Moisture content - gm/m3 (max)	0.05
6	Minimum capacity of each compressor (Nm3/hr.)	5.6
7	Design delivery pressure at its rated duty point Kg/cm2 (g)	150
8	Vibration level of compressor	As per internationally accepted standard
9	Noise level of compressor	85 dBA (to a reference of 0.0002 micro bar).

(BHEL)

CLAUSE NO.	PROJECT INFORMATION

ANNEXURE 3

WATER ANALYSIS

Sl.No.	Constituent	as	mg per litre
(c)	CLARIFIED WATER ANALYSIS (PT-CW)		
1.	Calcium	$CaCO_3$	143
2.	Magnesium	$CaCO_3$	40
3.	Sodium & Potassium	$CaCO_3$	65
4.	Bicarbonates	$CaCO_3$	126
5.	Chloride	$CaCO_3$	10
6.	Sulphate	$CaCO_3$	102
7.	Nitrate	$CaCO_3$	10
8.	Carbonate	$CaCO_3$	0
9.	Phosphate	$CaCO_3$	0
10.	Silica	SiO_2	1
11.	Iron	Fe	-
12.	pH Value	.	7. 5
13.	Turbidity	NTU	10
14.	Temperature (°C)		Ambient
Note : At the outlet of clarifier of PT Plant			
b)	FILTERED WATER ANALYSIS (DRINKING WATER)		
1.	Calcium	$CaCO_3$	143
2.	Magnesium	$CaCO_3$	40
3.	Sodium & Potassium	$CaCO_3$	65
4.	Bicarbonates	$CaCO_3$	126
5.	Chloride	$CaCO_3$	10
6.	Sulphate	$CaCO_3$	102
7.	Nitrate	$CaCO_3$	10
8.	Carbonate	$CaCO_3$	0
9.	Phosphate	$CaCO_3$	0
10.	Silica	SiO_2	1
11.	Iron	Fe	-
12.	pH Value	.	7.5
13.	Turbidity	NTU	2

QUALITY PLANS

CLAUSE NO.	QUALITY ASSURANCE

MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)

MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)

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

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

Note: **1) Detailed procedure of Burn-in and Elevated Temperature test shall be as per Quality Assurance Programme in General Technical Conditions**

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

TESTS / ITEMS	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Requirement as per standard (R)	WPS approval (A)	Non-destructive testing (R)	Calculation for accuracy (R)	Insulation Resistance (R)	IBR Certification as applicable (R)	Hydro test (R)	Material test certificate (A)
15. Cold junction compensation box	Y	Y	Y	Y					Y			
16. Orifice plate(BS-1042)	Y	Y	Y	Y*	Y	Y**	Y**			Y	Y**	Y
17. Flow nozzle(BS-1042)	Y	Y	Y	Y*	Y	Y	Y			Y	Y	Y
18. Impact head type element	Y	Y	Y					Y				Y
19. Level transmitter/float type switch	Y	Y	Y	Y					Y	Y	Y	Y
20. Flue Gas analyser	Y	Y	Y	Y								
21. Dust emission monitors	Y	Y	Y	Y								
*Calibration to be carried out on one flow element of each type and size if calibration carried out as type test same shall not be repeated.												
** If applicable												

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

Note: 1) Detailed procedure of Burn-in and Elevated Temperature test shall be as per Quality Assurance Programme in General Technical Conditions

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

INSTRUMENTATION CABLES.

INSTRUMENTATION CABLE

TESTS / ITEMS	Visual, Surface finish (A)	Constructional detail, dimensions (A)	Outer-Sheathe/core marking, end	FRLS Test * (A)	Insulation Resistance (A)	High Voltage ®	Spark Test Report Review ®	Volume Resistively (A)	Conductor Resistance ®	Electrical Parameters ** (A)	Tensile Elongation before & after	Thermal Stability (A)	Overall/Coverage/Continuity (A)	Persulphate Test (A)	Flamability Test *** (A)
1. Instrument cable twisted and shielded															
Conductor(IS-8130)	Y	Y							Y						
Insulation(VDE-207)	Y	Y	Y				Y				Y	Y			
Pairing/Twisting	Y	Y	Y												
Shielding	Y	Y											Y		
Drain wire	Y	Y							Y				Y	Y	
Inner Sheath	Y	Y	Y	Y							Y	Y			
Outer Sheath	Y	Y	Y	Y							Y	Y			
Over all cable	Y	Y	Y		Y	Y		Y	Y	Y					Y
Cable Drums(IS-10418)	Y	Y													

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

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

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

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

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

PLC BASED CONTROL AND INSTRUMENTATION FOR PLANT AUXILIARY SYSTEMS

PROGRAMMABLE LOGIC CONTRLLER

TESTS / ITEMS	Visual ®	GA, BOM ,Lay Out of components ®	Dimensions ®	Paint Shade/ Thickness/Adhesion ®	Alignment of Section ®	Component Rating/ Make / Type ®	Wiring ®	IR & HV ®	Review of TC for instruments/ Devices/ Recorders, Indicators/ Mosaic Items/ Transducers ®	Accessibility of TBS/ Devices ®	Illumination ®	Functional Check for Control Element , Annunciation ®	Mimic ®	Test as per IEC 1131 ® *	Test as per Std ® & (A)
1. PLC Panel	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y			Y	Y
2. Control Desk With PLC	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		

Note: **1) Detailed procedure of Burn-in and Elevated Temperature test shall be as per Quality Assurance Programme in General Technical Conditions**

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

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

CLAUSE NO.	QUALITY ASSURANCE

ELECTRIC POWER SUPPLY SYSTEM

Attributes / Characteristics → / 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
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 : 1202)	Y			Y						Y			
Push Buttons (IS : 4794)	Y			Y						Y			
MCB (IS : 8828)	Y			Y						Y			
PVC insulated Copper control wires (IS : 694)	Y			Y									
Sheet Steel (IS : 513)	Y	Y	Y	Y									
Synthetic Rubber Gaskets	Y	Y		Y									
Annunciator	Y									Y		Y	
Battery Charger	Y				Y	Y	Y	Y	Y		Y	Y	Y

Notes: 1. Detailed procedure of Burn-in and Elevated Temperature test shall be as per Quality Assurance Programme in General Technical Conditions

2. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the Practice and procedure along with relevant supporting documents.

3. Makes of all major Bought Out Items will be subject to NTPC approval.

CLAUSE NO.	QUALITY ASSURANCE

POWER SUPPLY SYSTEM

TESTS / ITEMS	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 Burn-in and Elevated Temperature test shall be as per Quality Assurance Programme in General Technical Conditions**

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

CLAUSE NO.	QUALITY ASSURANCE

HYDROGEN GENERATION PLANT

HYDROGEN GENERATION PLANT-TESTS

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

1.Fillet welds/nozzles welds and knuckle portion of dished ends and all butt welds.

2. 100% butt welds and 100% for Tee joints and dished ends welds.

3. One per heat /HT batch.

Notes.

1.Quantum of checks shall be 100% unless otherwise specified.

CLAUSE NO.	QUALITY ASSURANCE

LT SWITCHGEAR & BUSDUCT

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. & relevent standards.
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 (IS : 9431, IS : 10912, IEC : 660)	Y	Y	Y	Y			Y							
Air Circuit Breaker (IS: 13947)	Y	Y				Y	Y			Y	Y			Y
Energy Meters (IS : 722)	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 : 6875)	Y	Y				Y	Y			Y				
CT's & PT's (IS 2705 / 3156)	Y	Y					Y							Y
MCCB (IS : 13947)	Y	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 / 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. & relevent standards.
Fuse (IS 13703)	Y	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.	All routine tests as per relavent standards.
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 (BS : 2782, IEC : 660, IS : 10912)	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	Y

Notes:

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

CLAUSE NO.	QUALITY ASSURANCE

MOTORS

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
Plates for stator frame,end shield, spider etc.	Y	Y	Y	Y					Y
Shaft	Y	Y	Y	Y	Y	Y			Y
Magnetic Material	Y	Y	Y	Y	Y		Y		
Rotor Copper/Aluminium	Y	Y	Y	Y		Y	Y		Y
Stator copper	Y	Y	Y	Y			Y		Y
SC Ring	Y	Y	Y	Y	Y	Y	Y	Y	Y
Insulating Material	Y		Y	Y			Y		
Tubes for Cooler	Y	Y	Y	Y	Y				Y
Sleeve Bearing	Y	Y	Y	Y	Y				Y
Stator/Rotor, Exciter Coils	Y	Y	Y				Y	Y	
Castings, stator frame,terminal box and bearing housing etc.	Y	Y	Y	Y	Y			Y	
Fabrication & machining of stator, rotor, terminal box	Y	Y			Y				Y
Wound stator	Y	Y					Y	Y	
Wound Exciter	Y	Y					Y	Y	
Rotor complete	Y	Y					Y		
Exciter, Stator, Rotor, Terminal Box assembly	Y	Y					Y		
Accessories, RTD, BTD,CT, Brushes, Diodes,Space heater, antifriction bearing, cable glands, lugs, gaskets etc.	Y	Y	Y						
Motor (IS 325 / 4722/ 9283)	Y	Y	Y						

INDUCTION MOTOR & SYNCHRONOUS MACHINE (Contd.)

TESTS/CHECKS / ITEMS/COMPONENTS	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.									
Shaft									
Magnetic Material	Y		Y						
Rotor Copper/Aluminium									
Stator copper			Y						
SC Ring									
Insulating Material			Y						
Tubes for Cooler		Y							
Sleeve Bearing		Y							
Stator/Rotor, Exciter Coils									
Castings, stator frame,terminal box and bearing housing etc.									
Fabrication & machining of stator, rotor, terminal box									
Wound stator									
Wound Exciter									
Rotor complete				Y	Y				
Exciter, Stator, Rotor, Terminal Box assembly									
Accessories, RTD, BTD,CT, Brushes, Diodes,Space heater, antifriction bearing, cable glands, lugs, gaskets etc.									
Motor (IS 325 / 4722 / 9283)						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 alongwith relevant supporting documents during QP finalisation. However QP approval is not envisaged for LT motors upto 50 KW.
2. Makes of all major bought out items shall be subject to Employer's approval.

Y1 = for HT Motor / Machines only.

LT POWER CABLES

Item / Components / Sub System Assembly \ Attributes / Characteristics	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 & sheath	Thermal Stability of insulation and sheath *	Anti ternite treatment test	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/ IS 10810 (Part-58) IEC-60754 Part-I	Y		Y								Y					
Armour wire/ Formed wire (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-60754 Part-I Swedish Chimney SS 4241475 for (F3 category)/ Flamability test IEC-60332 Part-3 Cab-B	Y	Y							Y	Y	Y	Y	Y	Y	Y	Y
Wooden drum (IS-10418) / Steel drum		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. Not applicable for XLPE insulation

	ROUTINE TESTS **Routine test 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 GS wires / Formed wires only
8)	Uniformity of Zinc coating	For GS wires / Formed wires only
9)	Adhesion test	For 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 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-60754 (Part-I)
6)	Flammability test as per IEC-60332-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 wires / formed wires

CLAUSE NO.	QUALITY ASSURANCE

LT CONTROL 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 & sheath	Thermal stability of insulation and sheath	Anti termite treatment test	Constructional feature as per NTPC	Routine & Acceptance test as per relevant standard & NTPC specification	FRLS Test
Copper Conductor (IS-8130)	Y	Y	Y	Y	Y										
PVC Compound (IS-5831)	Y		Y		Y					Y					
FRLS PVC Compound IS-5831 / IS 10810 (Part-58)	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/IS10810 (Part-58) IEC-60754 Part-1 Swedish Chimney: SEN SS 424-1475(F3 category) Flammability test IEC-60332 Part-3 Cat-B	Y	Y						Y	Y	Y	Y		Y	Y	Y
Wooden drum(IS:10418) / Steel drum		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.															

	ROUTINE TESTS **Routine test 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 GS wires / Formed wires only
8)	Uniformity of Zinc coating For GS wires / Formed wires only
9)	Adhesion test For GS 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 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-60754 (Part-I)
6)	Flammability test as per IEC-60332-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 wires / formed wires