



**Technical Specification**  
**220V DC & 48V DC LEAD ACID PLANTE TYPE BATTERY**

Rev. No. 00

**SECTION - 1**

**SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES**

**1.0 SCOPE**

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of 220V DC & 48V DC Lead acid plante type Batteries complete with rack assembly and other accessories as required for trouble free operation of batteries.

This section covers the specific technical requirements of 220V & 48V Batteries. In case of any discrepancies between the requirements mentioned in this section and those specified in the following sections of this specification, the specifications given herein shall prevail and shall be treated as binding requirements.

In case of variance in the requirements specified under Section-1 and other Sections of this specification, requirements of Section-1 shall prevail.

No deviation from the requirements specified in various clauses of this specification shall be allowed. A certificate to this effect shall have to be furnished along with the offer as per attached Annexure-1.

**1.1 The equipment is required for the following project.**

**CUSTOMER: NTPC**

**CONTRACTOR: Bharat Heavy Electricals Ltd**

**PROJECT: FEROZE GANDHI UCHAHAR THERMAL POWER PROJECT STAGE –IV (1X 500MW)**

Refer Section - 3 for Project Details and General Specifications.

**1.2 SPECIFIC TECHNICAL REQUIREMENTS**

Parameter	220V DC	48 DC
Nominal Voltage Rating(V)	220	48
Cell designation	Stationary, Lead acid Type with plante positive Plates, High Discharge Rate type	
Charging method	Float Charging during normal conditions and Boost charging of battery after emergency duty. The Battery shall float across charger through a suitable tap during Boost charging.	

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Parameter	220V DC	48 DC
No. of Cells per battery	108	24
Maximum Battery Bank Voltage(Volt)	242	52.8
Minimum Battery Bank Voltage(Volt)	198	43.2
Cell Float Voltage(Volt)	2.25	2.25
End Cell Voltage(Volt)	1.85	1.85
Min. Electrolyte temp. for Battery Sizing	15°C	
Min. Ambient design temperature	0°C	
Battery Charging Requirement	Battery shall be such that it can be charged from fully drained state to fully charged condition within 5 Hrs.	
BATTERY ROOM SIZE	8500x10500 mm, bidder to confirm that all battery banks can be suitably accommodated in room size with 1.0 meter clear space from inside wall surface. refer sketch of room attached along with section-II	

The 220V DC system shall comprise of two batteries, two float–cum Boost chargers.

48V DC system shall comprise of two batteries, two float cum boost chargers.

For detailed technical requirement refer to section-I, Annexure-A, Page 1 to 4.

### 1.3 QUANTITIES

#### 1.3.1 MAIN QUANTITIES

Following are the quantities for Lead Acid Plante type Battery Bank complete with accessories, as per this specification. Bidder to quote price for all Items individually.

S.No.	Description	Quantity (in Nos.)
1	220V Lead Acid Plante type high discharge battery bank complete in all respect, meeting the load cycle requirement as per Tech. Spec.	02
2	48V Lead Acid Plante type high discharge battery bank complete in all respect, meeting the load cycle requirement as per Tech. Spec.	02
3.	48V Lead Acid Plante type high discharge battery bank complete in all respect, 400AH *	02

Please Note:-

- Refer Annexure-B of section-1 for 220V Load Duty Cycle.
- Refer Annexure-C of section-1 for 48V Load Duty Cycle.

\* The Battery size 400 AH mentioned against S-No-3 is subject to change by +/- 20% before placement of order.

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- c) The minimum size of batteries shall be as below ( For SNo. 1,2 of BOQ)
1. 220V- 400AH, LEAD ACID PLANTE TYPE
  2. 48V- 425AH, LEAD ACID PLANTE TYPE
- d) Each Battery bank shall comprise of:-
1. Battery
  2. Wooden Stand. For Battery Bank
  3. Intercell connector for Battery bank
  4. Electrolyte(Sulphuric Acid for first filling with 10% Extra)

**\* Bidder to quote battery Size meeting the load duty cycle requirement, submit the calculation for adequacy along with offer for review.**

**\* Ageing factor of 1.25 to be considered during sizing, temperature correction factor shall be as per manufacture’s recommendations & relevant standards.**

**\* The battery size quoted by bidder shall be with sufficient margin.**

**1.3.2 ACCESSORIES REQUIRED**

The following accessories and devices required for maintenance and testing of batteries shall be provided for each set of battery bank: [ TOTAL OF 6 BATTERY BANK ]

Sl. no.	Description	Quantity (in Nos.) [ PER BATTERY BANK ]
1.	Hydrometer	2
2.	Set of hydrometer syringes suitable for the vent holes in different cells	2
3.	Acid mixings jars	2
4.	Specific gravity correction chart	2
5.	Rubber apron	5
6.	Pair of rubber hand gloves	5
7.	No smoking notice	2
8.	Goggles (industrial)	2
9.	Instruction card	5
10.	Minimum and maximum temperature indicator	1
11.	Set of spanners	5

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12.	Cell testing voltmeter(3-0-3V)	1
13.	Wall mounting type holder for hydrometer thermometer	2
14.	Thermometer for measuring electrolyte temperature	2

**1.3.3 SPARES**

**Each Battery bank shall be supplied with following spares:**

S.no.	Item Description	Quantity
1	Complete dry cell	2% or 2 Nos. whichever is more
1	Intercell connectors with hardware	10% or 5 Nos. whichever is more
2	Vent plug	10% or 5 Nos. whichever is more
3	Acid level indicating float ( for opaque containers only)	10% or 5 Nos. whichever is more
4	Stand insulator	10% or 5 Nos. whichever is more
5	Cell insulator	10% or 5 Nos. whichever is more

Notes:

- (i) Purchaser shall have the option to order any / no Spares.

**1.3.4 SUPERVISION AT SITE**

Bidders shall quote for the following supervision charges:

S.N	SUPERVISION AT SITE	UNIT	QTY.
1	Supervision of Erection at site for 220V Lead Acid PLANTE type high discharge battery bank	Nos	2
2	Supervision of Erection at site for 48V Lead Acid PLANTE type high discharge battery bank	Nos	4
3	Supervision of testing and commissioning at site for 220V Lead Acid PLANTE type high discharge battery bank	Nos	2
4	Supervision of testing and commissioning at site for 48V Lead Acid PLANTE type high discharge battery bank	Nos	4

**1.4 TYPE TEST REPORTS**

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The 220V DC & 48V DC Lead acid plante type Batteries to be supplied shall be of type tested design. During detail engineering, the Bidder / Contractor shall furnish for Owner's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening **Date of bid opening is 15.11.2013.** These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

However if contractor is not able to submit report of type test(s) conducted in last ten years from the date of bid opening, or in case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval.

All acceptance and routine tests as per specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

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

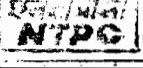

#### 1.5 PRE QUALIFYING REQUIREMENTS – TECHNICAL

Sub-vendor should have manufactured and supplied at least two (2) numbers of minimum 220V, 1000AH rating high discharge type plante positive plate type battery (in case bidder offers Lead Acid plante type battery) at least one (1) each at two (2) different industrial installations, which should be in successful operation for at least two (2) years as on **date of bid opening is 15.11.2013.**

#### 1.6 MANUFACTURING QUALITY PLAN

Manufacturer shall follow NTPC Manufacturing Quality Plan.

# Annexure - A

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>			
	<p>(e.) Air pressure test      The plates shall be designed for maximum durability during all service conditions including all service conditions.</p> <p>(f.) Ampere-hour capacity</p> <p>(g.) Retention of charge</p> <p>(h.) Insulation resistance</p> <p>The Contractor shall arrange for all necessary equipment, including the variable resistor, tools, tackles and instruments.</p>			
	<b>PART-B: LEAD -ACID PLANTE BATTERY ✓</b>			
<b>6.00.00</b>	<b>CODES &amp; STANDARDS</b>			
6.01.00	<p>All standards, specification and codes of practice, referred to herein, shall be the latest edition including all applicable official amendments and revisions as on date of opening of bid.</p> <p>In case of conflict between this specification and those (IS Codes Standards etc.) referred to herein, the former shall prevail. All works shall be carried out as per the following standards and codes:</p> <p>IS : 266      Specification for sulphuric acid</p> <p>IS : 1069      Specification for water for storage batteries</p> <p>IS : 1146      Specification for rubber &amp; plastic containers for lead acid storage batteries.</p> <p>IS : 1652      Specification for stationary cells and batteries, lead acid type (with plante positive plates).</p> <p>IS : 3116      Specification for sealing compound for lead acid batteries.</p> <p>IS : 8320      General requirements and methods of tests for lead acid storage batteries.</p> <p>IS : 6071      Specification for synthetic separators for lead acid batteries.</p> <p style="padding-left: 40px;">Indian Electricity Rules</p> <p style="padding-left: 40px;">Indian Electricity Acts</p>			
6.02.00	<p>Equipment complying with other internationally accepted standards such as IEC, BS, VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards alongwith copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.</p>			
<b>7.00.00</b>	<b>GENERAL TECHNICAL REQUIREMENTS</b>			
7.01.00	<p><b>Equipments</b></p> <p>DC Batteries shall be stationary lead acid Plante positive plate type conforming to IS:1652. The battery shall be high discharge performance type. For the purpose of design an ambient temperature of 50 degree centigrade and relative humidity of 85% shall be considered.</p>			
	<b>FGUTPP-IV (1X500 MW) EPC PACKAGE</b>	<b>TECHNICAL SPECIFICATIONS SECTION - VI PART-B</b>	<b>SUB-SECTION-B-27 BATTERY</b>	<b>PAGE 5 OF 8</b>



	<p>DC Batteries shall be suitable for standby duty. The Batteries shall normally be permanently connected to the load in parallel with a charger and shall supply the load during emergency conditions when AC supplies are lost. Batteries shall be suitable for a long life under continuous float operations and occasional discharges. The batteries shall be boost charged at about 2.7 volts per cell maximum and float charged at about 2.25 V/cell:</p> <p>The number of cells for the 220 Volts shall be 107 &amp; number of cell for 110V shall be 54.</p> <p>Batteries should be suitable for continuous operation for the maximum ambient temperature as defined in technical parameters.</p>
7.02.00	Construction Features
7.02.01	<p>Containers</p> <p>Containers shall be made of transparent glass, hard rubber, suitable robust, heat resistance, leak proof, non absorbent, acid resistant, non-bulging type and free from flaws, such as wrinkles, cracks, blisters, pin holes etc. Electrolyte level lines shall be marked on container in case of transparent containers. Float type level indicator shall be provided in case of opaque containers. The stem portion of the float should be long enough to prevent falling of the float inside the container even if there is no electrolyte in the container. The marking for the electrolyte level should be for the upper and lower limits. The material of level indicator shall be acid proof and oxidation proof. Container shall be closed/sealed lid type. Lid and sealing compound shall be non-cracking type. The container made of hard rubber and plastics shall be type tested as per IS : 1146. All type tests shall be carried out for sealing compound as per IS:3116.</p> <p>The pole sealing arrangement should be such that no acid particle get entrapped due to acid creep as a result of capillary action and it should be possible to remove and refix the sealing to carry out the maintenance.</p>
7.02.02	<p>Vent Plugs</p> <p>Vent plugs shall be provided in each cells. They shall be antisplash type, having more than one exit hole shall allow the gases to escape freely but shall prevent acid from coming out. The design shall be such that the water loss due to evaporation is kept to minimum. In addition the ventilator shall be easily removed for topping up the cells and of such dimensions that the syringe type hydrometer can be inserted into the vent to take electrolyte sample.</p>
7.02.03	<p>Plates</p> <p>The plates shall be designed for maximum durability during all service conditions including high rate of discharge and rapid fluctuations of load. The construction of plates shall conform to latest revisions of IS : 1652 as applicable.</p> <p>The separators shall maintain the electrical insulation between the plates and shall allow the electrolyte to flow freely. Separators should be suitable for continuous immersion in the electrolyte without distortion. The positive and negative post shall be clearly marked.</p>
7.02.04	<p>Sediment Space</p> <p>Sufficient sediment space shall be provided so that cells will not have to be cleaned during normal life and prevent shorts within the cells.</p>

<p>FGUTPP-IV (1X500 MW) EPC PACKAGE</p>	<p>TECHNICAL SPECIFICATIONS SECTION - VI PART-B</p>	<p>SUB-SECTION-B-27 BATTERY</p>	<p>PAGE 8 OF 8</p>
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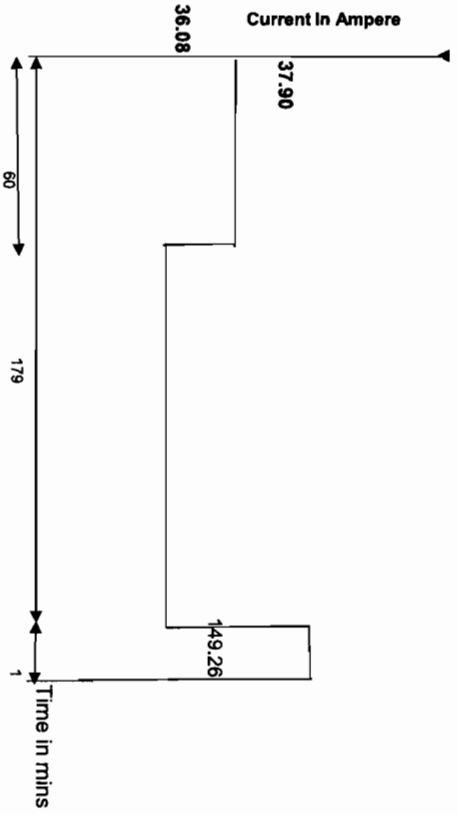


CLAUSE NO.	TEC. REQUIREMENTS TECHNICAL REQUIREMENTS		
8.00.00 8.01.00 8.02.00 8.03.00	<p><b>TESTS</b></p> <p><b>GENERAL</b></p> <p>The Contractor shall submit for Owner's approval the reports of all the type tests as per latest IS-1146 (for rubber &amp; plastic containers for lead-acid storage batteries)/IS 1652 (for lead-acid plate batteries) carried out within last ten years from the date of bid opening and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The complete type test reports shall be for any rating of battery in a particular group, based on plate dimensions being manufactured by supplier.</p> <p>Routine and Acceptance tests shall be as per Quality Assurance &amp; Inspection table of battery. <b>(ANNEXURE D)</b></p> <p><b>Commissioning Checks:</b></p> <p>All tests as listed below shall be carried out on sample cell selected at random by the employer at site after completion of installation.</p> <ol style="list-style-type: none"> <li>1) Verification of markings.</li> <li>2) Verification of dimensions.</li> <li>3) Test for capacities for 10 hrs discharge rate alongwith the test for voltage during discharge.</li> </ol> <p>The Contractor shall arrange for all necessary equipment, including the variable resistor, tools, tackles and instruments.</p>		
<p>FGUTPP-IV (1X500 MW) EPC PACKAGE</p>	<p>TECHNICAL SPECIFICATIONS SECTION - VI PART-B</p>	<p>SUB-SECTION-B-27 BATTERY</p>	<p>PAGE 8 OF 8</p>

Anne Xyre - B

**220 V PLANTE BATTERY& BATTERY CHARGER SIZING CALCULATION**

**Duty curve for 220V Battery-400kV Yard of Unchahar TPP Stage-IV**



LOAD & CORRESPONDING DURATIONS		
LOAD A1(Amps.)	38	60 min
LOAD A2(Amps.)	36	179min
LOAD A3(Amps.)	149.26	1 min

Continuous Load + emergency Lighting in control room  
 Continuous Load  
 Momentary load + Continuous Load

- Max. Ambient Temperature = 50 °C
- Min. Ambient Temperature = 0 °C
- System Voltage = 220 VDC at battery end
- Max. Voltage= (sys. vol. +10%) = 242 VDC at battery end
- Min. Voltage = (sys. vol. -10%) = 198 VDC at battery end
- Cell Float Voltage = 2.25 VDC
- Nominal Cell Voltage = 2.00 VDC
- Min. expected electrolyte Temperature - t 15.0 °C
- Temperature correction factor as per Battery Manufacturer's recommendation

- No. of Cells = Max. DC / Float Voltage = 107.56 nos.
- Hence no. of cells required = 108 nos.
- Hence no. of cells selected = 108 nos.
- Calculated End Cell Voltage = min. DC vol / no. of cells = 1.83 V

Annexure - B

**NTPC Document Number- : 1450-001R-SWYD-PVE-U-020**

Taking ECV at 1.85V the min. battery voltage becomes 199.8V which is more than the desired min. voltage of 187.0V. Hence,

Selected End Cell Voltage (ECV) =	1.85 VDC
Maximum Battery Bank Voltage =	242 VDC
Minimum Battery Bank Voltage =	199.8 VDC
No. of Cells =	108 Nos.
Permissible voltage drop (from battery to loads) = 199.8 - 187	= 12.8
	V

**BATTERY SIZE:**

*The battery size shall be calculated as per above Load duty cycle to meet the load requirements.*

**220 V DC BATTERY CHARGER SIZING CALCULATION**

**Float Charger Rating**

Continuous load (36A) + 25% of Continuous Load = 45.10 A

Total Continuous Load = 45.10 A

Trickle charging current considered @ 2.5 mA per AH

**Total Float current = Total Continuous Load (45.10A) + Trickle Charging current considered 2.5mA per AH**

**Boost Charger Rating**

Boost charger rating is selected at 15% of AH capacity of battery

**The rating of charger is decided as per higher current rating (Float mode or boost mode).**

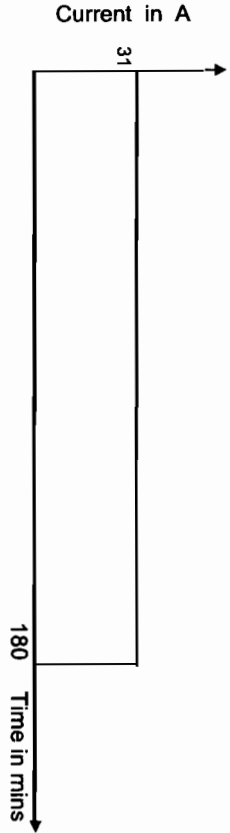
- Reference Standards:**
- IEEE-485 IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications
  - IS-8320 General requirements and methods of test for lead acid batteries
  - IS-1652 Stationary cells and batteries, lead acid types - plant type
  - IS-266 Specification sulphuric acid

Annexure - C

**48 V PLANTE BATTERY & BATTERY CHARGER SIZING CALCULATION**

Duty curve for 48V Battery -400kV Yard of Unchahar TPP Stage-IV

**Duty Curve for 48 V Battery**



LOAD & CORRESPONDING DURATIONS	
LOAD A1(Amps)	31   180 min

Max. Ambient Temperature = 50 °C  
 Min. Ambient Temperature = 0 °C  
 System Voltage = 48 VDC at battery end  
 Max. Voltage= (sys. vol. +10%) = 52.8 VDC at battery end  
 Min. Voltage = (sys. vol. -10%) = 43.2 VDC at battery end  
 Cell Float Voltage = 2.25 VDC  
 Nominal Cell Voltage = 2.00 VDC  
 Min. expected electrolyte Temperature - t 15.0 °C  
 Temperature correction factor as per Battery Manufacturer's recommendation

No. of Cells = Max. DC / Float Voltage = 23.47 nos.  
 Hence no. of cells required = 24 nos.  
 Hence no. of cells selected = 24 nos.  
 End Cell Voltage = min. DC vol./ no. of cells = 1.80 V

Taking ECV at 1.85V the min. battery voltage becomes 44.4V which is more than the desired min. voltage of 40.8V. Hence,  
 Selected End Cell Voltage (ECV) = 1.85 VDC  
 Maximum Battery Bank Voltage = 52.8 VDC  
 Minimum Battery Bank Voltage = 44.4 VDC  
 No. of Cells = 24 Nos.

**BATTERY SIZE:**  
*The battery size shall be calculated as per above load duty cycle to meet the load requirements.*

Annexure - C

NTPC Document Number : 1450-001R-SWYD-PVE-U-020

48 V DC BATTERY CHARGER SIZING CALCULATION

**Float Charger Rating**

Continuous load (31A) + 25% continuous load = 38.75 A

**Total Continuous Load = 38.75 A (1)**

Trickle charging current considered @ 2.5 mA per AH

**Total Float current = Total Continuous Load (38.75A) + Trickle Charging current considered 2.5mA per AH**

**Boost Charger Rating**


Boost charger rating is selected @15% of AH capacity of battery

**The rating of charger is decided as per higher current rating (Float mode or boost mode).**

**Reference Standards:**

- IEEE-485 IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications
- IS-8320 General requirements and methods of test for lead acid batteries
- IS-1652 Stationary cells and batteries, lead acid types - plante type
- IS-266 Specification sulphuric acid

# Annexure - D

CLAUSE NO.	Quality Assurance																	
<b>POWER SUPPLY SYSTEM</b>																		
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)	Premiinary light load test(R)	Load transfer retransfer test (R) *	AC input failure and return test (R)	Parralel operation and current divison(R)	Relative harmonic content(R)	Restart with PRI A.C and battery (separately)(R)	System transfer and retransfer (R)*	Asynchronous transfer(R)	Ripple content(R)	Load limiter operation (R)	IR/HV(R)	Tests as per standard & specification (R)&(A)
	UPS/CONVERTER (IEC-146 PT-4)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	VOLTAGE STABILISER	Y	Y	Y	Y	Y					Y		Y				Y	
	LEAD ACID BATTERY (TUBLAR)-IS-1651																	Y
	LEAD ACID BATTERY (PLANTE)-IS-1652																	Y
	NICKEL CADMIUM BATTERY(IS-10918/IEC-623)																	Y
		R-Routine Test			A- Acceptance Test					Y – Test applicable								
<p>* Transfer time and Over shoot /under shoot during load &amp; system transfer shall be recorded .</p> <p><b>Note:</b> 1) Detailed procedure of Environmental Stress Screening test shall be as per Quality Assurance Programme in General Technical Conditions</p> <p>2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.</p>																		

## SECTION 2

### EQUIPMENT SPECIFICATION

#### 2.1 GENERAL

This section covers the general technical requirements of 220V DC & 48V DC Lead acid plante type Batteries. In case of any discrepancies between the requirements mentioned in this section and those specified in the following sections of this specification, the specifications given herein shall prevail and shall be treated as binding requirements. Requirements of Section-1 shall take precedence over all sections.

#### 2.2 GENERAL TECHNICAL SPECIFICATIONS

As per NTPC Technical Specifications enclosed as below:

- i) FGUTPP-IV (1X500MW) EPC package, Technical Specification: Section-VI, Part-B, Technical Specifications, Sub Section-B-27, BATTERY, Page 1 to 8.  
REFER ANNEXURE - A OF SECTION - 1.

#### 2.3 PACKING AND MARKING

- The cells shall be suitably packed in wooden cases so as to avoid any loss or damage during transit.
- The packing wood shall be as per IS:190 - 1991 Grade I & IS:6662 - 1980, Grade III & IV.
- The base of the case shall be made of wooden batons & planks giving necessary reinforcement.
- Thickness of plank shall be minimum 25 mm and width shall not be less than 150 mm. The planks shall be fixed touching each other.
- Top cover will have a layer at 175 micron thick polyethylene sheet. The sheet should project about 150 mm on all the four sides at the top cover.
- Loose item such as connectors, copper rods, hardware, insulators and accessories etc. shall also be packed in cases.

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### Shipping Documents

#### 1. Inside the Case

The shipping documents including drawings (as applicable) storing instructions etc. should be placed in a polyethylene bag and nailed at the top of one of the side walls. The position should be easily visible and accessible.

#### 2. Outside the Case

The shipping documents should be put in a polyethylene bag and covered with a sheet metal cover, nailed on the outside of the case, near the top of one of the sides.

#### 3. Closing the top

Place the top cover in such a way that the polyethylene sheet lining faces inside. Nail the top cover to the four sides securely by using good quality nails of suitable size.

#### 4. Strapping of the Case

Steel strips of minimum 20-25 mm width to IS:5872 , should be strapped round the case, tensioned and crimped. There should be at least two straps per case and these should be across the top and the base. Use same size of strap at the corners. Their number should be adequate to strengthen the case.

### 2.3 List of Documents to be Submitted at Tender and Contract Stage

1. Battery Layout
2. Guaranteed Technical Particulars
3. Drawing showing constructional details of the cell
4. GA of Stand
5. Cable Termination detail
6. Battery characteristics as follows :
  - a) Curve showing cell volts Vs. time at different discharge rates.
  - b) Curve showing cell volts Vs. time at different charging currents.
  - c) Ampere - hours capacity Vs years of service.
7. Technical literature/manuals on all major components
8. Bill of materials indicating complete list of materials, accessories, spares, components, makes of components, quantities and rating.
9. Type test reports in case the equipment has been type tested already.
10. Temperature correction curve
11. Capacity calculation curve for different ECV at different time periods
12. Instruction manual and cards

The instruction manual giving instruction for initial treatment and routine

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maintenance during service shall be supplied as per relevant standard.

The following information shall be provided on the instructions cards:

- i) Designation of cell.
- ii) AH capacity
- iii) Nominal voltage
- iv) Instruction for filling initial charges
- v) Normal and finishing charging rate
- vi) Maintenance Instructions.

Note – Except document at Sl. no. 12, all other documents shall be submitted at the tender stage.

## SECTION- 3

### PROJECT DETAILS AND GENERAL SPECIFICATIONS

#### 3.0 GENERAL

This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification.

The provisions under this section are intended to supplement general requirements for the materials, equipment and services covered under other sections of tender documents and are not exclusive. However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall prevail.

#### 3.1 PROJECT DETAILS

	Particular	Details
a)	Customer	NTPC Ltd.
b)	Engineer/Consultant/ Inspector	NTPC Ltd.
c)	Project Title	Feroze Gandhi Unchahar Thermal Power Station Stage IV : 400/220kV Switchyard
d)	Project Location	Place: Bounded by Khnapur, Faridpur & Khaliqpur villages. District: Raebareli State: U.P.
e)	Latitude & Longitude	North: 25°54'50" and East: 81°19'50"
f)	Nearest Railway Station	Unchahar
g)	Distance of project location from the Railway station	2 Km (approx.)
h)	Nearest Major Town	Mustafabad
i)	Distance of the town from the project site	3 Km.
j)	Nearest commercial airport	Lucknow
k)	Distance of airport from the project site	110 Km
<b><u>SITE CONDITIONS</u></b> (for design purposes)		
a)	Design ambient temperature	50°C ✓
b)	Maximum Relative humidity	95 %
c)	Height above mean sea level	Less than 1000 meters
d)	Pollution Severity	Heavily polluted (With Coal dust & Fly ash) and Highly Corrosive environment.
e)	Criteria for Wind Resistant design of structures and equipment	Standard Applicable - IS 875 (Part 3) 1987
f)	Basic Wind speed "Vb" at ten meters above the mean ground level.	47 m/ sec
g)	Category of terrain	Cat -2
h)	Risk Coefficient "K1"	1.07

##### 3.1.1 SYSTEM PARAMETERS:

Sl.No.	Parameters	400 kV	220 kV
1	Highest system voltage	420 kV rms	245 kVrms
2	Lightning Impulse voltage	±1425kVp	± 1050kVp
3	Switching impulse voltage	±1050kVp	-
4	Power frequency withstand for 1 min (rms)	630 kV(rms)	460 kV(rms)
5	Max. fault level (1 sec.)	50 kA	40kA
6	Minimum creepage distance	10500 mm	6125mm

### 3.1.2 AUXILIARY POWER:

Sl.No.	Nominal Connection Voltage	Variations in Voltage	Frequency	Phase	Neutral
1	415V	±10%	50 (+3% -5%)	3Phase , 4 Wire	Solidly Earthed
2	240V	±10%	50 (+3% -5%)	1 phase	Solidly Earthed

Combined variation of voltage and frequency shall be + 10%. Fault level of 415V system shall not be more than 45kA rms.

**3.1.3** The various minimum heights of the switchyard shall be as given below from plinth level:

Voltage	Equipment /1st Level	2nd Level	3rd Level	Peak
220kV	6000mm	11000mm	18000mm	9000mm
400kV (1½ breaker	8000mm	16000mm	--	9000mm

The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or support insulators to the bottom of the equipment structure, where it rests on the foundation pad shall be 2550mm.

### 3.2 INSTRUCTION TO BIDDERS:

The bidders shall submit the technical requirements, data and information as per the technical data sheets, provided in Section-4.

The bidders shall furnish catalogues, engineering data, technical information, design documents, drawings etc fully in conformity with the technical specification.

It is recognized that the bidders may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to the Purchaser. Unless brought out clearly, the Bidder shall be deemed to conform to this specification scrupulously. All deviations from the specification shall be clearly brought out in the respective schedule of deviations. Any discrepancy between the specification and the catalogues or the bid, if not clearly brought out in the schedule, will not be considered as valid deviation.

Except for lighting fixtures, wherever a material or article is specified or defined by the name of a particular brand, Manufacturer or Vendor, the specific name mentioned shall be understood as establishing type, function and quality and not as limiting competition. For lighting fixtures, makes shall be as defined in Section-Lighting System.

Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/ or needed for erection,

completion and safe operation of the equipment as required by applicable codes, though they may not have been specifically detailed in the Technical Specifications unless included in the list of exclusions. Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the switchyard unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost. All similar standard components/parts of similar standard equipment under supply shall be inter-changeable with one another.

The bidder shall supply type tested (including special tests as per tech. specification) equipment and materials. The test reports shall be furnished by the bidder along with equipment/ material drawings. In the event of any discrepancy in the test reports, (i.e., if any test report is not acceptable due to any design/ manufacturing changes or due to non-compliance with the Technical Specification and/ or applicable standard), the tests shall be carried out without any additional cost implication to the BHEL. BHEL reserves the right to get any or all type/tests conducted/repeated.

### **3.3 CODES AND STANDARDS**

The supplier is required to follow local statutory regulations stipulated in the latest amended Electricity Supply Act 1948 and Indian Electricity Rules 1956 (latest), and other local rules and regulations.

The equipment to be furnished under this specification shall conform to latest issue with all amendments of standards and/ or codes specified under respective section heads. The standards mentioned in the specification are not mutually exclusive or complete in them, but intended to complement each other. The supplier shall also note that list of standards presented in this specification is not complete. Whenever necessary the list standards shall be considered in conjunction with specific IS/IEC. When the specified requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

Other internationally accepted standards which ensure equivalent or better performance that specified in the standards referred under section shall also be acceptable.

In case governing standards for the equivalent for the equipment is different from IS/ IEC, the salient points of difference shall be clearly brought out in additional information schedule along with English language version of standard of relevant extract of the same. The equipment conforming to standards other than IS/ IEC shall be subject to Purchaser's approval.

In addition to codes and standards specifically mentioned in the relevant technical specifications also refer **Annexure C.1**.

The full names of the codes and standards mentioned in abbreviations under various equipment heads are as follows:

BS	British Standards
IEC/ CISPR	International Electro-technical Commission
IS	Bureau of Indian Standards
ISO	International Organization for Standards
NEMA	National Electric Manufacturers Association

### **3.4 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED**

The 400 kV system is being designed to limit the power frequency over voltage of 1.5 p.u. and the switching surge over voltage to 2.5 p.u. In 400 kV system the initial value of temporary over voltage could be 2.0 p.u. for 1-2 cycles. All the equipment/materials covered in this

specification shall perform all its function satisfactorily without undue strain, restrike etc. under such over voltage conditions. All equipment shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation. All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow, (not applicable for this project) short circuit etc for the equipment .

The equipment shall also comply with the following:

- a) All equipments shall be suitable for hot line washing.
- b) To facilitate erection of equipment, all items to be assembled at site shall be "match marked".
- c) Piping, if any, between equipment control cabinet or operating mechanism to marshalling box of the equipment shall bear proper identification to facilitate the connection at site.
- d) All equipment shall be supplied with necessary inter-pole cabling, and its cost shall be included in the cost of equipment.

### **3.5 ENGINEERING DATA**

#### **3.5.1 Drawings**

All drawings submitted by the supplier including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required. The dimensions required for installation and interconnections with other equipment and materials, clearances and spaces required for installation and interconnections between various portions of equipment and any other information specifically requested in the specifications.

Each drawing submitted by the Contractor (including those of sub-vendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

After the approval of the drawings, further work by the Contractor shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Purchaser, if so required.

The review of these data by the purchaser will cover only general conformance of the data to the specification and documents, interfaces with the equipment provided under specification, external connections and of the dimensions which might affect substation layout. This review by the purchaser may not indicate a thorough review of the dimensions, quantities and details of the equipment, material, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the purchaser shall not be considered by the contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Purchaser. Approval of Contractor's drawing or work by the Purchaser shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

All engineering data submitted by the contractor after final process including review and approval by the purchaser shall form part of the contract document and the entire work performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the purchaser in writing.

### 3.5.2 Approval Procedure

The following procedure for submission and review/approval of the drawings, data, reports, information, etc. shall be followed by Contractor:

- a. All data/information furnished by Vendor in the form of drawings, documents, Catalogues or in any other form for NTPC's information/interface and/or review and approval are referred by the general term "drawings".
- b. The 'Master drawings list' shall be submitted for review and approval of Employer before award of contract. The Contractor shall have to prepare and submit any other drawings and reference documents in addition to the drawings contained in the list, if so required during engineering stage as felt necessary by the Employer. Number of copies of the list for the distribution shall be as mutually agreed between Contractor and Employer.
- c. All drawings (including those of sub vendors') shall bear at the right hand bottom corner the 'title block' with all relevant information duly filled in. The format of title block shall approved by Engineer within thirty (30) days after the letter of award. The Contractor shall give this format to his sub vendor along with his purchase order for sub vendor's compliance. The size of title block basic format and its contents shall not be changed. All drawings shall be in English language. All dimensions shall be in metric units.
- d. Contractor shall submit all the drawings in five (5) copies for review of Employer. Employer shall forward their comments within four (4) weeks of receipt of drawings.
- e. Upon review of each drawings, depending on the correctness and completeness of the drawings, the same will be categorised and approval accorded in one of the following categories:

CATEGORY I	Approved
CATEGORY II	Approved subject to incorporation of comments/modification as noted. Resubmit revised drawing incorporating the comments
CATEGORY III	Not approved. Resubmit revised drawings for Approval after incorporating comments/modifications as noted
CATEGORY IV	For information and records

- f. Contractor shall resubmit the drawings approved under Category II and III within one (1) week of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision number enclosed in a triangle (e.g 1.2.3. etc.)
- g. In case Contractor does not agree with any specific comment, he shall furnish the explanation for the same to Employer consideration. In all such cases Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.

- h. It is the responsibility of the Contractor to get all the drawings approved in the Category I or IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.
- i. Contractor shall not make any changes in the portion of the drawing other than those commented. If changes are required to be made in the portions already approved, the Contractor shall resubmit the drawings identifying the changes (along with reasons for changes) for Employer's review and approval.
- j. Approval of drawings will not in any way relieve the Contractor of his obligations of furnishing the equipment in accordance with the specification and shall not prevent subsequent rejection if such equipment is later found to be defective.
- k. The drawing approval progress report shall be submitted in at least three (3) copies within one (1) week from the last date of the every month.

### **3.5.3 Erection Drawings.**

- a. Contractor shall furnish erection drawings for the guidance or commencement of erection or the first shipment, whichever is earlier. These shall generally comprise of fabrication/assembly drawings, various component/part details drawing, assembly, clearance data requirements, etc. The drawings shall contain details of components/equipment with identification number, match marks, bill of materials, assembly procedures etc.
- b. For all major equipment apart from above details, assembly sequence and instructions with check-lists shall be furnished in the form of erection manuals.

### **3.5.4 Instruction Manual**

- a. The Contractor shall submit to the Employer preliminary instruction manuals for all the equipments for review. The final instructions manuals incorporating Employer's comments and complete in all respect shall be submitted at least sixty (60) days before the first shipment of the equipment. The instruction manuals shall contain full details and drawings of all the equipments, the transportation, storage, installation, testing, operation and maintenance procedures, etc. separately for each component/equipment along with log record format. These instruction manuals shall be submitted in five (5) copies for approval.
- b. If after commissioning and initial operation of the plant, the instruction manuals require any modifications/additions/changes, the same shall being corporate and the updated final instruction manuals shall be submitted.
- c. The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall have sufficient details to enable the Employer to maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give a step by step procedure for all operations likely to be carried out during the life of the plant/equipment, including erection, testing, commissioning, operation, maintenance dismantling and repair. Each manual shall also include a complete set of approved drawings together with performance/rating curves of the equipment and test certificates, wherever applicable. The contract shall not be considered completed for purpose of taking over until such instructions and drawings have been supplied to the Employer.

- d. A separate section of the manual shall be for each size/type of equipment and shall contain a detailed description of construction and operation, together with all relevant pamphlets.
- e. The manuals shall include the following
  - a) List of spare parts along with their drawing and catalogues and procedure for ordering spares.
  - b) Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation.
- f. Where applicable, fault location charts shall be included to facilitate finding the cause of mal-operation or break down.
- g. A collection of the manufacturer's standard leaflets will not be accepted to be taken as a compliance of this clause. The manual shall be specifically compiled for the concerned project.

### **3.5.5 Final Submission of drawings and documents:**

The Contractor shall furnish the following after approval of all drawings /documents and test reports:

- a. List of drawings bearing the Employer's and Contractor's drawing number.
- b. Two (2) bound sets along with 4 CD-ROMs of all drawings.
- c. All documents/designs in two (2) copies as noted above.
- d. Contractor shall also furnish two (2) bound sets of all as-built drawings including the list of all as-built drawings bearing drawing numbers. The Contractor shall also furnish one (1) set of film reproduces or CD-ROMs of all as-built drawings as decided by the Employer.
- e. The Contractor shall also furnish three (3) copies of instruction manuals (after approval) for all the equipments.

### **3.5.6 TEST REPORTS**

Two (2) copies of all test reports shall be supplied for approval before shipment of Equipment. The report shall indicate clearly the standard value specified for each test to facilitate checking of the reports. After final approval seven bound copies of all type and routine test reports shall be submitted to Employer.

### **WORKMANSHIP**

Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended and shall ensure satisfactory performance throughout the service life.

In case where the equipment, materials or components are indicated in the specification as "similar" to any special standard the purchaser shall decide upon the question of similarity. When required by the specification or when required by the purchaser the contractor shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the Contractor.

The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each

component shall be designed to be consistent with its duty and suitable factors of safety subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Purchaser.

Whenever possible, all similar part of the works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the equipment supplied under the specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable. The equipment offered in the bid only shall be accepted for supply, with the minimum modifications as agreed/accepted.

### 3.7 LIMIT OF CONTRACT

All the equipment, materials and services furnished by the manufacturer shall be complete in every respect with all mountings, fitting, fixtures and standard accessories normally provided with such equipment, and needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in technical specification and unless included in the list of exclusions. The manufacturer shall supply at no extra cost to Employer any additional material/service not covered specifically but which are found to be required for fulfillment of the scope of work under specification.

### **3.8 PROVISIONS FOR EXPOSURE TO HOT AND HUMID CLIMATE**

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity' heavy rainfall and environment favorable to the growth of fungi and mildew. The indoor equipment located in non-air-conditioned areas shall also be of same type.

#### **SPACE HEATERS**

The heaters shall be suitable for continuous operation at 230 V as supply voltage. On –off switch and fuse shall be provided.

One or more adequately rated thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the compartment and electrical connections shall be made sufficiently away from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

The heaters shall be suitably designed to prevent any contact between the heater wire and the air and shall consist of coiled resistance wire centered in a metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material having equal heat conducting and electrical insulation properties or they shall consist of resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and the air. Alternatively, they shall consist of a resistance wire mounted into a tubular ceramic body built into an envelope of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in vitreous glaze. The surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments.

#### **FUNGICIDIC VARNISH**

Besides the space heaters, special moisture and fungus resistance varnish shall be applied on parts which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

#### **Ventilation opening**

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

#### **Degree of Protection**

The enclosure of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall provide degree of protection as detailed here under:

- a. Installed outdoor: IP- 55
- b. Installed indoor in air conditioned area: IP-31
- c. Installed in covered area: IP-52
- d. Installed indoor in non air-conditioned area where possibility of entry of water is limited: IP-41.
- e. For LT Switchgear (AC & DC distribution Boards) : IP-52

The degree of protection shall be in accordance with IS: 13947 (Part –I) / IEC-947 (Part-I) / IS 12063/IEC 529. Type test report for degree of protection test, on each type of the box shall be submitted for approval.

### **3.9 RATING PLATES, NAME PLATES AND LABELS**

- 3.9.1 Each equipment shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.
- 3.9.2 The equipment nameplate should preferably be of stainless steel. In case of aluminium, it should be at least 2mm thick. The inscription on the nameplate shall be engraved and no punching shall be accepted except for equipment serial number and year of manufacture. These nameplates shall be black with white engraved lettering.
- 3.9.3 The rated current, extended current rating and rated thermal current shall be clearly indicated in the name plate in case of current transformer.
- 3.9.4 Rated voltage, voltage factor and intermediate voltage shall be clearly indicated on the nameplate in case of capacitor voltage transformer.
- 3.9.5 Name plates of cubicles and panels may be made of non-rusting metal or 3 ply lamicaid.
- 3.9.6 Each switch shall have a clear inscription identifying its function. Switches shall also have a clear inscription of each position indication.
- 3.9.7 All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.

### **3.10 GALVANISING:**

- 3.10.1 The galvanised surface shall consist of a continuous film adhering to the steel. The finished surface shall be clean and smooth, and shall be free from defects like dissolved patches, base, spot, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surfaces, flaking or peeling off, etc. The presence of any of these defects shall render the material liable to rejection.
- 3.10.2 All exposed ferrous parts shall be hot dip galvanised as per IS:2629 & IS:2633, Galvanising shall be uniform, smooth continuous and free from acid spots. Should the galvanising of the sample be found defective, the entire batch of steel shall have to be re-galvanised at Contractor's cost. The amount of zinc deposit shall be not less than 610 gms. per sq.m. of surface area and in addition, the thickness of zinc at any spot shall not be less than 85 microns. The Employer reserves the right to measure the thickness of zinc deposit by Elkometer or any other instrument acceptable to Employer and reject any component which shows thickness of zinc at any location less than 85 microns. The testing on the galvanised materials shall be carried out as per IS:2633.
- 3.10.3 The amount of zinc deposit over threaded portion of the bolts, nuts and screws shall not be less than 300 gms. per sq. meter of surface area. The amount of zinc deposit on washers shall not be less than 340 gms. per sq. meter of surface area. The threads having extra deposit of zinc shall be removed by die cutting after the completion of galvanising. The removal of extra zinc shall be carefully done so that threads shall have minimum deposits of zinc on them as specified.

### **3.11 PAINTING**

The sheet steel to be painted shall be pre-treated in tanks in accordance with IS:6005. Degreasing shall be done by alkaline cleaning. Rust and scales shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be "class-C" as specified in IS:6005. The phosphated surfaces shall be rinsed and passivated prior to application of stoved lead oxide primer coating. After primer application, two coats of finishing synthetic enamel paint on panels shall be applied. Electrostatic painting shall also be acceptable. Finishing paint on outside of the panels shall be as required otherwise by the Employer. The inside of the panels shall be glossy white. Each coat of finishing shall be properly stoved. The paint thickness shall not be less than 50 microns. Finished parts shall be coated by peelable compound by spraying method to protect the finished surfaces from scratches, grease, dirt and oil spots during testing, transportation, handling and erection.

### **3.12 QUALITY ASSURANCE PROGRAMME**

- 3.12.1 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 subcontractor'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/IS- 14001.

A quality assurance programme of the contractor shall generally cover the following:

- i. His organisation structure for the management and implementation of the proposed quality assurance programme
- ii. Quality System Manual
- iii. Design Control System
- iv. Documentation Data Control System

- v. Qualification data for Bidder's key Personnel.
- vi. 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.
- vii. System for shop manufacturing and site erection controls including process, fabrication and assembly.
- viii. Control of non-conforming items and system for corrective actions and resolution of deviations.
- ix. Inspection and test procedure both for manufacture and field activities.
- x. Control of calibration and testing of measuring testing equipments.
- xi. System for Quality Audits.
- xii. System for identification and appraisal of inspection status.
- xiii. System for authorising release of manufactured product to the Employer.
- xiv. System for handling storage and delivery.
- xv. System for maintenance of records, and
- xvi. Furnishing 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'

### **3.13 GENERAL REQUIREMENTS - QUALITY ASSURANCE**

- 3.13.1 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. 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 should 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.
- 3.13.2 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 e.g. floppy or E-mail in addition to hard copy, for review. Once the same is finalised, hard copies shall be submitted for approval. After approval the same shall be submitted in compiled form on CD ROM.
- 3.13.3 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.
- 3.13.4 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.
- 3.13.5 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/Authorised representative 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.

- 3.13.6 No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch 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 MDCC.
- 3.13.7 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.
- 3.13.8 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.
- 3.13.9 All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.
- 3.13.10 All brazers, welders and welding operators employed on any part of the contract either in Contractor's/his 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.
- 3.13.11 Test results or qualification tests and specimen testing shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorised representative.
- 3.13.12 For all pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. Similarly, any other statutory requirements for the equipments/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding.
- 3.13.13 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
- 3.13.14 No welding shall be carried out on cast iron components for repair.
- 3.13.15 Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.
- 3.13.16 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). 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.

In general all plates of thickness greater than 40mm & for pressure parts plates of thickness equal to or greater than 25mm shall be ultrasonically tested otherwise as specified in respective equipment specification. All bar stock/Forging of diameter equal to or greater than 50mm shall be ultrasonically tested.

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 subcontractor 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 subcontractors 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. Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.

- 3.13.17 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 subcontractor 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.
- 3.13.18 Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub vendor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.
- 3.13.19 The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractors 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/equipments 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.
- 3.13.20 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.
- 3.13.21 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.
- 3.13.22 Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.

**3.13.23 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% whichever 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.

#### **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.

### **3.14 QUALITY ASSURANCE DOCUMENTS**

The Contractor shall be required to submit two hard copies and two sets on CDROM of the following Quality Assurance Documents as identified in respective quality plan with tick (  ) mark.

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 dispatch. However CD-Rom may be issued not later than three weeks.

**3.14.1 Typical contents of Quality Assurance Document are as below:-**

- i) Quality Plan,
- ii) Material mill test reports on components as specified by the specification and approved Quality Plans.
- iii) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.
- iv) Type test report (wherever applicable).
- v) 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.
- vi) Heat Treatment Certificate/Record (Time- temperature Chart)
- vii) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure). CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points.
- viii) Certificate of Conformance (COC) whoever applicable.
- ix) MDCC

**3.14.2** Similarly, the contractor shall be required to submit two hard copies and two sets on CD ROM of Quality Assurance Documents ( in line with above) pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.

**3.14.3** Before dispatch/ 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.

- i) If the result of the review carried out by the Inspector of the Quality document (or applicable section) is satisfactory. The Inspector shall stamp the quality document (or applicable section) for release.
- ii) If the quality document is unsatisfactory, the Supplier shall endeavour to correct the incompleteness, thus allowing finalizing 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.
- i) If a decision is made for dispatch, 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 dispatch of equipment.

**3.15 TRANSMISSION OF QUALITY DOCUMENTS**

As a general rule, two hard copies of the quality document and Two CD ROMs shall be issued to the Employer not later than 1 month after the delivery date for the corresponding equipment. One set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Site.

For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 1 month after the date of the last delivery similarly as stated above.

**3.16 INSPECTION, TESTING & INSPECTION CERTIFICATE**

- 3.16.1 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.
- 3.16.2 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.
- 3.16.3 The Contractor shall give the Project Manager/Inspector fifteen (15) 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, will attend such tests within fifteen (15) 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.
- 3.16.4 The Project Manager or Inspector shall within fifteen (15) 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.
- 3.16.5 When the factory tests have been completed at the Contractor's or subcontractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) 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.
- 3.16.6 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.
- 3.16.7 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.
- 3.16.8 To facilitate advance planning of inspection in addition to giving inspection notice, 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.

- 3.16.9 All inspection, measuring and test equipments 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 equipments in the presence of Project Manager / Inspector.

### **3.17 PACKAGING & TRANSPORTATION**

#### **3.17.1 Packing, Marking and shipping**

The packing and shipping shall be carried out in accordance with the standard practice of Contractor and with the following additional requirements:

- a) The equipment shall be prepared in such a manner as to protect the equipment from damage or deterioration during shipping or storage. The shipments can be exposed to heavy rains, hot sun, high humidity and sudden extreme changes of temperature. The equipment shall be packed and shipped so as to protect it from all such conditions and any other abnormal conditions, generally expected during shipping & storage.
- b) The metallic containers, if any, shall be considered as the property of the Contractor and he will be allowed to remove them from site once the contents are unpacked, inspected, documented and placed in temporary storage or in final position.
- c) The equipment shall be shipped in such a manner as to facilitate unloading, handling and storage enroute and at the site. The Contractor shall provide lifting lugs and special lifting devices for proper handling and erection.
- d) The Contractor shall be liable for any damage or loss resulting due to careless, improper, poor or insufficient packing and handling.
- e) Spare parts and spare equipment shall be packed separately in containers adequate for long term storage, plainly marked "Spare Parts Only". They shall be crated individually or in kits to be used in one single renewal or overhaul operation. Other spare part kits shall not be disturbed when using one set or kit.
- f) The Contractor shall at all times protect and preserve from damage, loss, corrosion and all other forms of damage, all parts of the works.

#### **3.17.2 Transportation**

- a) The Contractor shall make a careful examination of access rail/roadways to the site in order to confirm the practical maximum transport weight and dimensions as well as a careful examination of the ports of disembarkation particularly with respect to the capacity of the cranes installed and access roads.
- b) All instruments and computer/microprocessor based equipment imported into India from overseas for the purpose of this contract shall be air freighted to the nearest possible point and further by rail/road taking due precautions as per manufacturer's recommendations. Employer shall have the right to decide the items that should be air freighted and Employer's decision shall be binding on Contractor.

#### **3.17.3 Insurance**

- a) The Contractor shall insure all shipments and works at his own expense for not less than the

full replacement cost plus any additional cost for accelerated manufacturing of the replacement parts.

- b) Loss or the damage to equipment during shipping or transportation to the site(s) or otherwise shall not constitute grounds for claims for extension in time or for extra payment.

### **3.18 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS**

- 3.18.1 The material of clamps and connectors shall be Aluminium alloy casting conforming to designation A6 of IS:617 for connecting to equipment terminals and conductors of aluminium. In case the terminals are of copper, the same clamps/connectors shall be used with 2mm thick bimetallic liner.
- 3.18.2 The material of clamps and connectors shall be Galvanised mild steel for connecting to shield wire.
- 3.18.3 Bolts, nuts and plain washers shall be hot dip galvanised mild steel for sizes M12 and above. For sizes below M12, they shall be electro-galvanised mild steel. The spring washers shall be electro-galvanised mild steel.
- 3.18.4 All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be rounded off to meet specified corona and radio interference requirements.
- 3.18.5 They shall have same current rating as that of the connected equipment. All current carrying parts shall be at least 10 mm thick. The connectors shall be manufactured to have minimum contact resistance.
- 3.18.6 Flexible connectors, braids or laminated strips shall be made up of copper/aluminium.
- 3.18.7 Current rating and size of terminal/conductor for which connector is suitable shall be put on a suitable sticker on each component which should last atleast till erection time.

### **3.19 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES & MARSHALLING BOXES FOR OUTDOOR EQUIPMENT.**

- 3.19.1 All types of control cabinets, junction boxes, marshaling boxes, lighting panels, terminal boxes, operating mechanism boxes, Kiosks etc. shall generally conform to IS:5039, IS:8623 and IEC:439 as applicable.
- 3.19.2 They shall be of painted sheet steel or aluminium. The thickness of sheet steel shall be 2mm cold rolled or 2.5mm hot rolled. The thickness of aluminium shall be 3mm and shall provide rigidity. Top of the boxes shall be sloped towards rear of the box. The paint shall be of grey RAL 9002 on the outside and glossy white inside. However, the junction and switch boxes shall be of hot dip galvanised sheet steel of 1.6mm thickness.
- 3.19.3 The cabinets/boxes/kiosks/panels shall be free standing or wall mounting or pedestal mounting type. They shall have hinged doors with padlocking arrangement. All doors, removable covers and plates shall be gasketed all around with neoprene gaskets.
- 3.19.4 The degree of protection of all the outdoor boxes shall not be less than IP 55 as per IS 2147.
- 3.19.5 The cable entry shall be from bottom, for which removable gasketed cable gland plates shall be provided.

- 3.19.6 Suitable 240V, single phase, 50Hz ac heaters with thermostats controlled by switch and fuse shall be provided to maintain inside temperature 10deg. above the ambient.
- 3.19.7 The size of enclosure and the layout of equipment inside shall provide generous clearances. Each cabinet/box/kiosk/panel shall be provided with a 15A, 240V ac, 2 pole, 3 pin industrial grade receptacle with switch. For incoming supply, MCB of suitable rating shall be provided. Illumination of each compartment shall be with door operated incandescent lamp. All control switches shall be of rotary switch type.
- 3.19.8 Each cabinet/box/kiosk/panel shall be provided with two earthing pads to receive 75mmx12mm GS flat. The connection shall be bolted type with two bolts per pad. The hinged door shall be connected to body using flexible wire. The cabinets/boxes/kiosks/panels shall also be provided with danger plate, and internal wiring diagram pasted on inside of the door. The front label shall be on a 3mm thick plastic plate with white letters engraved on black background

### **3.20 TERMINAL BLOCKS**

- 3.20.1 They shall be non-disconnecting stud type of extensible design equivalent to Elmex type CAT-M4.
- 3.20.2 The terminal blocks shall be of 650 V grade, and rated to continuously carry maximum expected current. The conducting part shall be tinned or silver plated.
- 3.20.3 They shall be of moulded, non-inflammable thermosetting plastic. The material shall not deteriorate with varied conditions of temperature and humidity. The terminal blocks shall be fully enclosed with removable covers of transparent, non deteriorating plastic material. Insulating barriers shall be provided between the terminal blocks so that the barriers do not hinder the wiring operation without removing the barriers.
- 3.20.4 The terminals shall be provided with marking tags for wiring identification.
- 3.20.5 Unless otherwise required (expected current rating) or specified, terminal blocks shall be suitable for connecting the following conductors on each side:  
All CT & VT circuits - Min. four 2.5 sq.mm. copper flexible conductor  
AC & DC power supply - Two 16 sq.mm. Aluminium conductor  
Circuits  
Other control circuits - Min. two 2.5 sq.mm. copper flexible conductor.
- 3.20.6 The terminal blocks for CT and VT secondary leads shall be provided with test links and isolating facilities. CT secondary leads shall also be provided with short circuiting and earthing facilities.

### **3.21 Wiring**

- 3.21.1 All wiring shall be carried out with 1100 V grade stranded copper wires. The minimum size of the stranded conductor used for internal wiring shall be as follows:  
a) All circuits except CT circuits 2.5 sq.mm  
b) CT circuits 4 sq. mm (minimum number of strands shall be 3 per conductor).
- 3.21.2 All internal wiring shall be securely supported, neatly arranged readily accessible and connected to equipment terminals and terminal blocks.
- 3.21.3 Wire terminations shall be made with solderless crimping type of tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with the wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wires

shall not fall off when the wires and shall not fall off when the wire is disconnected from terminal blocks.

- 3.21.4 All wires directly connected to trip circuit breaker shall be distinguished by the addition of a red coloured unlettered ferrule. Number 6 & 9 shall not be included for ferrules purposes.
- 3.21.5 All terminals including spare terminals of auxiliary equipment shall be wired upto terminal blocks. Each equipment shall have its own central control cabinet in which all contacts including spare contacts from all poles shall be wired out. Interpole cabling for all equipment's shall be carried out by the Contractor.

### **3.22 CABLE GLANDS AND LUGS**

- 3.22.1 Cable glands shall be Double compression type, tinned/Nicked plated (coating thickness not less than 20 microns in case of tin and 10 to 15 microns in case of nickel) brass cable glands for all power and control cables. They shall provide dust and weather proof terminations. They shall comprise of heavy duty brass casting, machine finished and tinned to avoid corrosion and oxidation. Rubber components used in cable glands shall be neoprene and off tested quality. Required number of packing glands to close unused openings in gland plates shall also be provided.
- 3.22.2 The cable glands shall be tested as per BS:6121. The cable glands shall also be duly tested for dust proof and weather proof termination.
- 3.22.3 Cables lugs shall be tinned copper solder less crimping type conforming to IS:8309 and 8394 suitable for aluminum or copper conductor (as applicable). The cable lugs shall suit the type of terminals provided. The cable lugs shall be of Dowell make or equivalent.

### **3.23 CONDUITS, PIPES AND ACCESSORIES**

- 3.23.1 The bidder shall supply and install all rigid conduits, mild steel pipes, flexible conduits, hume pipes, etc. including all necessary sundry materials, such as tees, elbows, check nuts, bushing reduces, enlargers, wooden plugs, coupling caps, nipples, gland sealing fittings, pull boxes, etc.
- 3.23.2 Rigid conduits shall be flow-coat metal conduits of Nagarjuna Coated Tubes or equivalent make. The outer surface of the conduits shall be coated with hot-dip zinc and chromate conversion coatings. The inner surface shall have silicone epoxy ester coating for easy cable pulling. Mild steel pipes shall be hot-dip galvanised. All rigid conduits/ pipes shall be of a reputed make.
- 3.23.3 Flexible conduits shall be heat-resistant lead coated steel, water-leak, fire and rust proof, and be of PLICA make or equivalent.

### **3.24 MOTOR CONTROL CENTRE**

- 3.24.1 The 415 Volt motor control centres (if provided separately) shall conform to the requirements for boxes/cabinets/kiosks. They shall be fixed type, shall be fully sectionalised and shall be equipped with load break switches. Motor feeders shall be provided with isolating switch fuse unit and Contractor with thermal overload relay and single phase protection. The motor Contractor shall have one normally open auxiliary contact for alarm purposes. The motor control circuit shall be independent from all other control circuits.
- 3.24.2 Isolating Switches  
The incoming power supply isolating switch operation handle shall be interlocked with the control cabinet door as to prevent opening of door when main switch is closed. Device for by passing the door interlock shall also be provided. Switch handle shall have provision for locking in both fully open and fully closed positions.

### **3.24.3 Fuses**

All fuses shall be of the HRC cartridge type, conforming to IS: 2208 and suitable to mount on plug-in type of fuse bases. Fuses shall be provided with visible operation indicators to show that they have operated. All accessible live connections shall be adequately shrouded, and it shall be possible to change fuses with the circuit alive, without danger of contact with live conductor. Insulated fuse pulling handle shall be supplied with each control cabinet.

## **3.25 MOTORS**

**3.25.1 Motors shall be “Squirrel Cage” three phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment and shall conform to type tests and shall be subjected to routine tests as per applicable standards.**

### **3.25.2 Enclosures**

- a) For motors to be installed outdoor, the motor enclosure shall have degree of protection IP: 55. For motors to be installed indoor, i.e. inside a box, the motor enclosure shall be dust proof equivalent to IP: 44.
- b) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of earthing conductor.
- c) Motors shall have drain plugs so located that they will drain water resulting condensation or other causes from all pockets in the motor casing.

### **3.25.3 Operational Features :**

- a) Continuous motor ratings (name plate rating) shall be at least suitable for the driven equipment at design duty operating point of driven equipment that will arise in service.
- b) Motors shall be capable of giving rated output without reduction in the expected life span when operated continuously in the given system.

### **3.25.4 Starting Requirements**

- a) All induction motors shall be suitable for full voltage direct on-line starting. These shall be capable of starting and accelerating to the rated speed alongwith the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops.
- b) Motors shall be capable of withstanding the electrodynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.
- c) The locked rotor current shall not exceed six(6) times the rated full load current for all motors subject to tolerance given in IS:325.
- d) Motors when started with driven equipment imposing full starting torque and supply voltage conditions specified shall be capable of withstanding at least two successive starts from cold condition at room temperature and one start from hot condition without injurious heating of winding. The motors shall also be suitable for three equally spread starts per hour under the above referred supply condition.
- e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than starting time with the driven equipment of minimum permissible voltage by a least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement, the Contractor shall offer centrifugal type speed switch mounted on the motor shaft which shall remain closed for speeds lower than 20% and open for speeds above 20% of the rated. The speed switch shall be capable of withstanding 120% of the rated speed in either directions of rotation.

- 3.25.5 The maximum permissible temperature rise over the ambient temperature shall be within the limits specified in IS: 325 (for 3 phase induction motors) after adjustment due to increased ambient temperature specified.
- 3.25.6 The double amplitude of motor vibration shall be within the limits specified in IS:729. Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.
- 3.25.7 All the induction motors shall be capable of running at 80% of rated voltage for a period of 5 minutes.

### **3.26 AUXILIARY SWITCH**

- a) The auxiliary switch shall conform of following type tests:
- b) Electrical endurance test - A minimum of 1000 operations for 2A. D.C. with a time constant greater than or equal to 20 milliseconds with a subsequent examination of mV drop/ visual defects/ temperature rise test.
- c) Mechanical endurance test - A minimum of 5000 operations with a subsequent checking of contact pressure test/ visual examination
- d) Heat run test on contacts
- e) IR/HV test, etc.

### **3.27 LAMPS AND SOCKETS**

- 3.27.1 Lamps:  
All incandescent lamps shall use a socket base as per IS-1258, except in the case of signal lamps.
- 3.27.2 Sockets  
All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.
- 3.27.3 Hand Lamp:  
A 240 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON-OFF Switch for connection of hand lamps.

### **3.28 SWITCHES & FUSES**

Each control panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with switch-fuse units. Selection of the main and sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.

All fuses shall be of HRC cartridge type conforming to IS 9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal Protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the fuse rating and voltage.

All control switches shall be of rotary type. Toggle/piano switches shall not be accepted.

### **3.29 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS**

- 3.29.1 Bushings shall be manufactured and tested in accordance with IS: 2099 & IEC: 137 while hollow column insulators shall be manufactured and tested in accordance with IEC 233/IS 5284. The support insulators shall be manufactured and tested as per IS: 2544 / IEC 168/IEC 273. The insulators shall also conform to IEC 815 as applicable.
- 3.29.2 Support insulators/ bushings/ hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.
- 3.29.3 Porcelain used shall be homogenous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture. Hollow porcelain should be in one integral piece in green & fired stage.
- 3.29.4 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burns and other similar defects.
- 3.29.5 When operating at normal rated voltage there shall be no electric discharge between conductor and insulators which would cause corrosion or injury to conductors or when operating at normal rated voltage.
- 3.29.6 The design of the insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall be lead to deterioration. All ferrous parts shall be hot dip galvanised.
- 3.29.7 Contractor shall make available data on all the essential features of design including the method of assembly of shells and metal parts, number of shells per insulator, the manner in which mechanical stresses are transmitted through shells to adjacent parts, provision for meeting expansion stresses, results of corona and thermal shock tests, recommended working strength and any special design or arrangement employed to increase life under service conditions.
- 3.29.8 Post type insulators shall consist of a porcelain part permanently secured in metal base to be mounted on supporting structures. They shall be capable of being mounted upright. They shall be designed to withstand all shocks to which they may be subjected to during operation of the associated equipment.
- 3.29.9 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps, the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.
- 3.29.10 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued; porcelain parts by grinding and metal parts by machining. Insulator/ bushing design shall be such as to ensure a uniform compressive pressure on the joints.
- 3.29.11 Bushings, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests and acceptance test/ sample test in accordance with relevant standards.
- 3.29.12 Insulator shall also meet requirement of IEC - 815 as applicable, having alternate long & short sheds.

**3.30 TYPE, ROUTINE & ACCEPTANCE TESTS:**

All equipments to be supplied shall be of type tested design. During contract stage, bidder shall submit for Owner's approval the reports of all the type tests listed in this specification and carried out within last ten years from the date **17.06.13**. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the tests should have been either conducted at an independent laboratory or should have been witnessed by a client.

However if contractor is not able to submit report of the type tests conducted within ten years from the date **17.06.13**, or in the case of type test reports are not found to be meeting the specification requirements, the bidder shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/ owners representative and submit the reports for approval.

All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

**3.31 CORONA AND RIV TESTS AND SEISMIC WITHSTAND TEST:**

- a) The corona (for 400kV only) and RIV tests shall confirm to the requirements as per Annexure A.
- b) The seismic withstand test for 400kV shall conform to requirements as per Annexure B.

**3.32 Enclosures:**

1. ANNEXURE- A - CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST
2. ANNEXURE- B - SEISMIC WITHSTAND TEST

CLAUSE NO. FEATURES	TECHNICAL REQUIREMENTS
	<p style="text-align: right;"><b>ANNEXURE - A</b></p> <p><b>CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST</b></p> <p><b>1.00.00 General</b></p> <p>Unless otherwise stipulated, all equipment together with its associated connectors, where applicable, shall be tested for external Corona both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and by measurement of radio interference voltage (RIV).</p> <p><b>2.00.00 Test Levels:</b></p> <p>The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.</p> <p><b>3.00.00 Test Methods for RIV:</b></p> <p>RIV tests shall be made according to measuring circuit as per International Special-committee on Radio Interference (CISPR) Publication 16-1 (1993) Part-I. The measuring circuit shall preferably be tuned to frequency with 10% of 0.5 MHz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The results shall be in microvolts.</p> <p>Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107-1964, except otherwise noted herein.</p> <p>In measurement of RIV temporary additional external corona shielding may be provided. In measurement of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.</p> <p>Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, 115% and 130% for the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 420kV 7 220KV is listed in the detailed specification together with maximum permissible RIV level in microvolts.</p> <p>The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.</p> <p>The RIV measurement may be made with a noise meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to voltage read by noise meter.</p>

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CLAUSE NO. FEATURES	TECHNICAL REQUIREMENTS
4.00.00	<p><b>Test Methods for Visible Corona</b></p> <p>The purpose of this test is to determine the corona extinction voltage of apparatus, connectors, etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised and lowered to determine their precise values. The test voltage shall be raised to 130% of RIV test voltage and maintained there for five minutes. In case corona inception does not take place at 130%, the voltage shall be raised further till inception of corona or 420kV whichever is minimum. Thereafter the voltage will be decreased slowly until all visible corona disappears. The procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona (negative or positive polarity) disappears.</p> <p>The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.</p> <p>However, both tests shall be carried out with the same test set up and as little time duration between tests as possible. No modification on treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of Owner's engineer if, in his opinion, it will not prejudice other test.</p>

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CLAUSE NO. FEATURES	TECHNICAL REQUIREMENTS
	<p style="text-align: right;"><b>ANNEXURE - B</b></p> <p style="text-align: center;"><b>SEISMIC WITHSTAND TEST PROCEDURE</b></p> <p>The seismic withstanding test on the complete equipment (Except BPI) shall be carried out along with supporting structure.</p> <p>The Bidder shall arrange to transport the structure from his Contractor's premises/Owner's sites for the purpose of seismic withstand test only.</p> <p>The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the Terminal Pad of the equipment and any other point as agreed by the Owner. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the Purchaser.</p> <p>.....</p>

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**220V DC & 48V DC LEAD ACID PLANTE TYPE BATTERY**

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**SECTION-4**  
**GUARANTEED TECHNICAL PARTICULARS**

Sl. No.	ITEM DESCRIPTION	UNIT	220V	48V
1	Manufacturer's name			
3	Type of battery			
4	Manufacturer's catalogue reference			
5	Guaranteed Ah Capacity of battery at 27° C at 10 hour discharge rate with end of discharge voltage 1.85V per cell.	Ah		
6	Nominal voltage rating	V/cell		
7	Short circuit current for a short circuit at battery terminals	kA		
8	Duration for which battery can withstand short circuit current			
9	Cells: 1. No. of cells per battery 2. Type of the cell 3. Cell designation 4. Material of container 5. Overall dimensions of each cell 6. Sediment space (mm) 7. Net dry weight 8. Weight of cell with electrolyte 9. Recommended maximum period of storage before the first charge 10. Recommended cell centre to centre distance (mm)			
10	Inter cell connector: i) Material of connector ii) Type of insulation if provided			
11	Plates: i) No. of positive plates per cell ii) Type of positive plate iii) Type of negative plate			
12	Separator i) Type ii) Material			
13	Electrolyte i) Amount of electrolyte for first filling ii) Sp. gr. of electrolyte at 27 °C. - at the time of first filling - at the end of full charge - at the end of discharge at 10-h rate iii) Maximum electrolyte temperature	Litre		
14	Total shipping weight of electrolyte for one battery unit.	Kg		

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15	Total shipping weight of one battery unit (without electrolyte)	Kg		
16	Racks i) No. of racks per battery ii) No. of cells per rack iii) Material and finish of rack Paint shade Alkali / acid resistant coating detail			
17	Recommended boost charging current	A		
18	Recommended boost charging voltage	V/cell		
19	Recommended float charge voltage	V/cell		
20	Float charging trickle current	A		
21	Recommended equalize charge rate - Current - Voltage per cell - Duration for equalize charging - Frequency of equalize charging	A V/cell		
22	Internal resistance of each cell Fully charged condition Fully discharged condition			
23	Recommended air changes per hour			
24	Battery Charge-Discharge Curves Enclosed	Yes / No		
25	Applicable Standards	IEC		

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**SECTION-5**

**CHECKLIST FOR LEAD ACID BATTERY BANK**

Put a tick mark on 'YES' if the specified requirement is met, or put a tick mark on 'NO' if the specified requirement is not met and give comments in the remark column

**1. TECHNICAL REQUIREMENTS**

Sl. No.	Parameters	Required Value * 220V BATTERY	Required Value * 48V BATTERY	Bidder's Confirm- -ation	Reasons for non compliance
1.	Manufacturer's Identification System	As per clause 7.02.09 Annx-1	As per clause 7.02.09 Annx-1	YES/NO	
2.	Type	Lead Acid plante High discharge performance	Lead Acid plante High discharge performance	YES/NO	
3.	Nominal Voltage Rating (V)	220V	48V	YES/NO	
4.	Cell TYPE			YES/NO	
5.	Max. Suitable Temp.	50deg. C	50deg. C		
6.	Ah capacity at 27 deg.C at 10 hr discharge rate to end of discharge voltage 1.0V per cell	Complied	Complied	YES/NO	
7.	Nominal voltage per cell	2.0V	2.0V	YES/NO	
8.	End Cell Voltage for specified duty cycle	1.85V	1.85V	YES/NO	
9.	No. of Cells per battery bank	108	24	YES/NO	
10.	Cell container	As per clause 7.02.01 Annx-A	As per clause 7.02.01 Annx-A	YES/NO	
11.	Type of Stand offered (freestanding on floor complete with necessary hardware)	As per clause 7.02.08 Annx-A	As per clause 7.02.08 Annx-A	YES/NO	
12.	Vent plugs	As per clause 7.02.02 Annx-A	As per clause 7.02.02 Annx-A	YES/NO	
13.	Plates	As per clause 7.02.03 Annx-A	As per clause 7.02.03 Annx-A	YES/NO	
14.	Cell Insulator	As per clause 7.02.05 Annx-A	As per clause 7.02.04 Annx-A	YES/NO	

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15.	Electrolyte	As per clause 7.02.06 Annx-A	As per clause 7.02.06 Annx-A		
16.	Connectors and Fasteners	As per clause 7.02.07 Annx-A	As per clause 7.02.07 Annx-A		
17.	Battery racks	As per clause 7.02.08 Annx-A	As per clause 7.02.08 Annx-A	YES/NO	
18.	Arrangement for connection for cell tapping provided for continuity during boost charging?	Yes	Yes	YES/NO	
19.	Applicable standard	As per clause 6.00.00 Annx-A	As per clause 6.00.00 Annx-A	YES/NO	
20.	Accessories as per clause 1.3.2 of section-1 included in the scope of supplies	YES	YES	YES/NO	
21.	Mandatory spares quoted in line with clause 1.3.3 of section-1	YES	YES	YES/NO	
22.	Supply of electrolyte for first filling plus 10% extra with the battery bank	YES	YES	YES/NO	
23.	All routine & acceptance tests to be conducted	As per clause 8.02.00	As per clause 8.02.00	YES/NO	

~~\* BIDDOR is required to fill in the specified parameter values specific to each enquiry at the time of issuance of specification.~~

24. sizing calculations for deciding Ampere Hour Rating of Battery as per specified duty cycle (Annexure B, C) has been submitted along with offer for review.

YES / NO

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**SECTION-5**

**2. TYPE TESTS**

1. Whether the offered equipment has been type tested within Ten years from the date of bid opening (**Date of bid opening is 15.11.2013**) and valid reports are available.

**YES /NO**

2. If yes, furnish the report number.

Sl. No.	TESTS	REPORT NO.	YES/NO
1.	Test for capacity and voltage during discharge		
2.	Ampere hour and watt-hour efficiency test		
3.	Test for loss of capacity		
4.	Endurance test		

3. If case, the reports are not found complete / valid at contract ~~stage~~ stage, such type tests shall be carried out without any cost / delivery implication

( YES )

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