

# **KARNATAKA POWER TRANSMISSION CORPORATION LIMITED**

## **Section -Battery**

### **TECHNICAL SPECIFICATIONS FOR BATTERY FOR 220kV (GIS) AND 400kV (AIS & GIS) SUB- STATIONS 220 VOLTS, 600 AH CAPACITY**

#### **1.0 SCOPE:**

- 1.1 This specification covers the supply of battery system to feed the protection equipments and emergency lights in 220kV (GIS) and 400kV (AIS & GIS) Sub-stations.
- 1.2 This specification covers design, manufacture, supply, assembly, shop testing at manufacturer's works before despatch & delivery at site, erection, testing and commissioning of 220V, 600AH storage Lead Acid, high cyclability, high discharge type battery.
- 1.3 The scope of supply shall include all parts and accessories, etc. which are necessary for erection, safe operation and maintenance of battery banks.

#### **2.0 SPECIFICATION FOR 1 X 220 VOLTS, 600 AH BATTERY SETS:**

- 2.1 As detailed in clause 1.0 above, the battery sets are required for 220kV (GIS) and 400kV (AIS & GIS) Sub-stations.
- 2.2 The batteries shall be complete in all respects.
- 2.3 The battery shall be of Lead acid with Plante type or Grid Plate - Flat Pasted type Positive plates and Grid Plate - Flat pasted type Negative plates confirming to IS : 1652/ IS 6304 latest version. The positive plates shall resist the foaming action of the current during charge & discharge & retain its strength, rigidity, shape dimensions over the operating life of the plates. The Battery shall be suited for a long life under continuous float operation and occasional discharge.

#### **2.4 TEMPERATURE CONDITION:**

The batteries are required to operate under the following temperature conditions.  
Maximum temperature 50 degree centigrade

Minimum temperature	5 degree centigrade
Average rainfall	varies from 1000mm to 2000mm
Height above M.S.L.	Below 1000 mtrs.
Relative humidity	95%

## 2.5 **STANDARD:**

The batteries shall fully conform to the latest edition of following standards or any other equivalent international Standard.

### **A LIST OF RELEVANT STANDARDS IS GIVEN BELOW:**

- i). IS-1652 - Specification for stationery cells and batteries, lead Acid type with Plante Positive Plates.
- ii) IS-6304 - Specification for stationery cells and batteries, Lead Acid type with Flat pasted Positive Plates.
- iii) IEC- 60896-11 - Stationary Lead Acid Batteries – Vented type: General requirement & methods of test.
- iv).IS- 266 - Specification for Sulphuric Acid
- v). IS- 6071 - Specification for synthetic separators for lead acid batteries.
- vi) IS- 1069 - Specification for quality tolerances water for storage batteries
- vii)IS- 1146 - Specification for rubber and plastic containers for lead acid storage batteries.
- viii)IS- 8320 - General requirements and methods of tests for lead-acid storage batteries.
- ix) IS-1885-Part-8 - Electro technical vocabulary – stationary cells & batteries
- x) IEEE- 485 - IEEE recommended practice for sizing large lead storage batteries for generating stations and sub-stations.
- xi) IS- 3116 - Specification for sealing compound for lead acid batteries.
- xii)IS- 1248 - Indicating instruments.
- xiii) IEEE – 484 - Recommended design for installation.

## 2.6 **Design and Construction Details:**

### 2.6.1 **Rating:**

The batteries are intended to supply power at 220V to the protection equipments in the sub-stations. Each battery set shall contain 110 cells of normal voltage of 2 volts. The batteries are required to supply indicating lamps, the coils & control scheme of breakers and disconnectors of GIS, relays & station emergency lighting etc. Batteries shall normally remain under floating condition with the trickle charger supplying the continuous load.

The following particulars shall be noted:

- |    |                                 |         |
|----|---------------------------------|---------|
| a) | Normal voltage                  | 220V    |
| b) | Float charge voltage            | 198-280 |
| c) | Boost/Equalizing charge voltage | 190-300 |
| d) | Ampere hour capacity            | 600AH   |

Note: Bidder shall furnish calculation in support of Battery sizing, selection of number of cells, float and boost voltages, float & boost currents during detailed engineering for owner's acceptance. Battery sizing calculations shall be done as per IEE-485.

## 2.6.2 CONTAINERS:

The Container material shall be of Halogen free SAN container and have Chemical & Electro- chemical compatibility shall be acid resistant, heat resistant, have good surface appearance & excellent transparency for ease of maintenance and shall have adequate mechanical strength to prevent bulging, cracking, etc. throughout their service life when operating under expected temperature range, static and dynamic loads and action of electrolyte. The material shall meet all the requirement of Plante/ Flat Pasted type batteries and be consistent with the life of battery. The container shall be low inflammable. The Tensile strength of material of container shall be such as to handle the internal pressure of the cells in worst working conditions. Cell shall not show any deformity or bulge on the sides under all working conditions. The containers shall be of robust construction and free from flaws, bubbles or foreign matter. The Container shall be capable of withstanding the rigours of transport, storage and handling. The containers shall conform to IS – 1146/Relevant standard.

The containers shall be mounted on insulator blocks. Routine and Acceptance tests shall be as per the requirements of IS- 1146/Relevant standard. The label attached to the containers shall be marked with the information as per requirements of Cl. No. 2.2 of the above standard. The supplier's/manufacture's test certificates shall

be submitted by the tenderer for the scrutiny of the purchaser.

#### **2.6.3 Cell Covers:**

The covers shall be made of Halogen free SAN material compatible with container material, permanently fixed with the container & provided with vent plug. It shall be capable to withstand internal pressure without bulging or cracking. It shall also be fire retardant. It should be easily removable if the need arises.

#### **2.6.4 END CELL TAPPING:**

The tenders should clarify as to whether it is preferable to have end cell tapping arrangement in the battery banks in order to control the voltage of the load side, when the battery banks are being boost charged or not. If end cell tapping is recommended to regulate the voltage across load, battery set supplier should agree to supply necessary switch to cut-in /cut-out the cells and also supply end cells as loose item.

#### **2.6.5 Terminal Posts:**

Both the +ve and –ve terminals of the cells shall be of proper termination and shall ensure its consistency with the life of the battery. The surface of the terminal post extending above the cell cover including bolt hole shall be coated with an acid resistant and corrosion retardant material. Terminal posts or any other metal part which is in contact with the electrolyte shall be made of the same alloy as that of the plates or of a proven material that does not have any harmful effect on cell performance. Both +ve and –ve posts shall be clearly and unambiguously identifiable.

The battery terminals shall be brought out in a junction box to be mounted on the battery stands.

#### **2.6.6 Connectors, Nuts & Bolts, Heat shrinkable sleeves:**

Where it is not possible to bolt the cell terminals directly to assemble a battery, separate non-corroding lead or copper connectors of suitable size shall be provided to enable connection of the cells. Copper connections shall be suitably lead coated or fully rubber moulded to withstand corrosion due to sulphuric acid at a very high rate of charge or discharge.

Nuts & Bolts for connecting the cells shall be made of copper, brass or stainless steel. Copper or brass nuts & bolts shall be effectively lead coated or rubber moulded to prevent corrosion. Stainless steel bolts and nut can be used without lead coating.

The connectors shall be of suitable cross-section to withstand all the working conditions including 1 min. discharge rate as well as short circuit condition.

All inter cell connectors shall be protected with heat shrinkable silicon sleeves for reducing the environmental impact including a corrosive environment.

#### **2.6.7 SEPARATORS:**

Microporous separators shall be used, which shall have high acid absorption capability, resistant to sulphuric acid, have good insulating properties and shall not exhibit any tendency to swell or shrink at temperature encountered during operation. Separators shall have adequate mechanical strength. The design of separator shall ensure that there is no misalignment during normal operation and handling. These shall permit free flow of electrolyte and would not be affected by chemical reaction inside the cell & shall last for indefinite time. The internal resistance factor of separators shall assure high discharge characteristics under all operating conditions.

#### **2.6.8 VENT PLUG:**

Vent plugs shall be provided in each cell. They shall be anti-splash type, preferably with more than one exit hole which shall allow the gases to escape freely, but shall effectively prevent acid particle or spray from coming out. On removal, the plugs shall permit drawing of the electrolyte sample for servicing, for topping up the cells and for checking of electrolyte level. The vent plugs shall be re-combiner type and shall be able to recombine the generated Hydrogen and Oxygen evolved into water and back to the cell so that evaporation is kept to minimum and reduces the top-up frequency during its life time.

#### **2.6.9 SEDIMENT SPACE:**

Sufficient sediment space shall be provided beneath the plates to accommodate any plate deposit, which shall accumulate at the bottom of the cell over a reasonable life of battery without short circuiting the plates.

#### **2.6.10 HYDROMETERS:**

Hydrometers suitable for floating in any Cell in the battery, & with a reasonably long scale permissible for the depth of the cell & capable of reading specific gravity 1.1 to 1.3 with sub-divisions 0.005 shall be provided. A wall mounting type teak wood holder for the hydrometer shall also be supplied.

#### **2.6.11 ELECTROLYTE:**

The full quantity of electrolyte required for the first filling with 10% extra shall be included in the offer. The electrolyte shall be supplied in Non-returnable acid resisting jars. The electrolyte shall generally conform to IS - 266 or equivalent international standards. The electrolyte shall have Specific gravity as per manufacturer's recommendation at 27°C. Sufficient quantity of distilled water conforming to IS – 1069 shall be supplied in non-returnable containers to correct the level of electrolyte during initial testing & commissioning.

#### **2.6.12 SUPPORTING RACKS OR STILLAGE FOR BATTERY BANK:**

All batteries shall be mounted on a suitable teakwood/ FRP stand. The stand shall be properly painted with the acid resistant paint. Suitable insulation shall be provided between stand/frame and floor to avoid the grounding of the frame/stand.

The Battery layout arrangement (single / double / step tier) is required to suit battery room dimensions as indicated in the layout plan of the station.

#### **2.6.13 MARKING ON OUTSIDE OF EACH CELL:**

- a. Name, type and trade mark of manufacturer.
- b. Country and year of manufacturer.
- c. Capacity at 10Hr discharge rate.
- d. Upper and lower electrolyte level.
- e. Serial number.
- f. Type of container.
- g. Polarity marking as per relevant IS
- h. Reference standard of battery.

#### **2.7 CAPACITY REQUIREMENT:**

When the battery is discharged at 10 hour rate, it shall deliver 100% of C (Where C is rated capacity, corrected at 27 degree Celsius) before any of the cells in the battery bank reaches 1.85 V/cell.

The battery shall be capable of being recharged from the fully exhausted condition (1.85 V/cell) within 10 Hrs upto 90% state of charge. All the cells in a battery shall be designed for continuous float operation at the specified float voltage throughout the life.

Loss in capacity during storage at an average ambient temperature of 35 degree Celsius for a period of 6 months shall not be more than 60% and the cell/battery shall achieve 85% of its rated capacity within 3 charge/discharge cycles and full rated capacity within 5 cycles, after the storage period of 6 months. Voltage of each cell in the battery set shall be within 0.05V of the average voltage

throughout the storage period. Ampere hour efficiency shall be better than 90% and watt hour efficiency shall be better than 80%.

## 2.8 EXPECTED BATTERY LIFE:

The battery shall be capable of giving 800 or more charge/discharge cycles at 80% depth of discharge (DOD) at an average temperature of 27 degree Celsius. DOD (Depth of discharge) is defined as the ratio of the quantity of electricity (in ampere-hour) removed from a cell or battery on discharge to its rated capacity. The battery sets shall have a minimum expected life of 20 years at float operation.

## 2.9 ACCESSORIES:

The following Battery Accessories shall be supplied:

Item	Quantity
a) Cell testing Voltmeter (range -3 -0- +3 volts) accuracy class 0.5 or better	1 No.
b) Rubber apron	2 Nos.
c) Rubber shoes (Knee height)	2 pairs
d) Thermometer (mercury/ alcohol type) (0° to 100 ° C) with separate gravity correction chart	2 Nos.
e) Acid Resistant funnels.	2 Nos.
f) Spanners	1 Set
g) Acid resisting jars 2 Ltrs capacity	2 Nos.
h) Rubber Gloves	2 pairs
i) Rubber Siphon	2 Nos.
j) Special tools required for connecting the terminals of batteries	2 Sets
k) Hydrometers	2Nos
l) Hydrometer syringe suitable for vent holes	2Nos
m) Wall mounting type holder for Hydrometer & Thermometer	2Nos
n) Pipette	1No

## 2.10 MAXIMUM SHORT CIRCUIT CURRENT:

The Bidder shall state the maximum short circuit current of each battery along with the safe duration in seconds which it can withstand. Methods, proposed to be adopted for protecting batteries from the short circuit conditions should also be stated to avoid damage to the battery and loss to the associated equipment.

## 2.11 VENTILATION:

The bidder shall indicate in his bid the requirements of ventilation in the battery room. The battery shall operate satisfactorily over the entire range of the temperature and humidity indicated in this specification without affecting its

normal life. If any special ventilation requirements are necessary the same shall be indicated.

**2.12 CHARGING:**

The bidders shall state whether an equalizing charge is recommended for the battery. If so, the equalizing charge voltage, current, duration and the interval between the equalizing charging shall be specified in the Data sheet. Bidder shall also indicate the requirements for boost charging

**2.13 PACKING:**

All materials shall be securely packed, crated & protected against mechanical damage in conformity 'With manufacturer's standard practice.

**2.-14 INSTRUCTION MANUALS:**

Eight sets of instruction manuals for installation, commissioning, charging and maintenance instruction along with its soft copies in CD/DVD's shall have to be furnished.

**2.16 Type Test of Battery:**

2.16.1 Type tested Batteries shall be offered. The type test reports shall not be older than Ten (10) years as on the last date of submission of bid.

**a) For Batteries manufactured in India:**

- i. Type tests on indigenous equipment for which testing facility is available in India, should have been conducted in any independent laboratories approved by Government or accredited by National accreditation body of the country like Central Power Research Institute (CPRI), Electrical Research and Development Association (ERDA), etc.
- ii. Type tests on indigenous equipment, for which testing facility is not available in India, should have been conducted in a laboratory of foreign country accredited by National accreditation body of that country.
- iii. The type tests conducted in-house by manufacturers shall also be acceptable provided the lab (manufacturer's) is accredited by National accreditation body of the country and the tests have been witnessed by a representative of NABL accredited Independent laboratory/Power utility.

**b) For Batteries manufactured Abroad:**



- i. Type tests on imported equipment should have been conducted in an Indian Laboratory or foreign laboratory accredited by National accreditation body of respective country.
- ii. Type tests conducted in-house by manufacturers shall also be acceptable provided the laboratory is accredited by National accreditation body of the country and the tests have been witnessed by a representative of accreditation body/Power utility.

Contractor shall submit type test reports of following tests as per latest version of IS1652, IS 6304 & IEC 60896-11.

- a) Verification of constructional requirements.
- b) Verification of dimensions.
- c) Test for capacity.
- d) Test for retention of charge.
- e) Endurance Test.
- f) Verification of marking.
- g) AH and Watt H efficiency test.
- h) Test for suitability for floating battery operation.
- i) Short circuit & internal resistance measurement.
- j) Test for voltage during discharge.

Tests shall be conducted in accordance with IS1652, IS 6304 & IEC 60896-11.

#### 2.16.2 List of Factory & Site tests for Battery:

Sl.No.	Test	Factory Tests	Site Tests
1.	Physical verification		Yes
2.	Test for capacity for 10 hours discharge rate along with the test for voltage during discharge	Yes	Yes

#### 2.17 Installation & Commissioning:

Manufacturer of Battery shall supervise the installation and commissioning and perform commissioning tests as recommended in O&M manual / or relevant standards. All necessary instruments, material, tools & tackles required for installation, testing at site and commissioning are to be arranged by Battery manufacturer/Contractor.

#### 2.18 DRAWINGS AND OTHER DOCUMENTS:

The tenderer shall submit the following drawings/ documents along with his offer failing which the offer is liable for rejection.

- a). General battery arrangement, proposed size of individual and over all dimensions along with sectional views showing all connections etc.
- b). Pamphlets and technical literature giving detailed information of the batteries offered.

Contractor shall submit following documents for approval:

- (a) Data sheet / GTP as per Annexure-I
- (b) GA of cell and layout drawing
- (c) Discharge data for 10 Hour, 8 Hour, 3 Hour, 2 Hour, 1 Hour, 15 minutes and One minute indicating capacity factors for end cell voltage of 1.75 V & 1.85 V.
- (d) Temperature correction factors.
- (e) Installation & Commissioning instructions.
- (f) O&M manual.

#### **2.19 GUARANTEED TECHNICAL PARTICULARS:**

The Guaranteed technical particulars, as called for in the 'Annexure' shall be furnished along with the tender.

## ANNEXURE

### **GUARANTEED TECHNICAL PARTICULARS:**

<b>Sl. No.</b>	<b>PARTICULARS</b>	<b>Units</b>	<b>220V, 600AH Battery sets</b>
1	Type of Cell		
2	Plante/Grid plate Type reference:		
3	Nominal Voltage per cell	Volts	
4	Manufacture's Name		
5	Standards to which battery is manufactured		
6	IS Nomenclature		
7	Number of cells in the battery bank		
8	Nominal Voltage of Battery	Volts	
9	Declared Capacity at 27 degree C upto 1.85 ecv i). Initial ii). Rated iii). End of Life	AH AH AH	
10	Rated Capacity at minimum ambient temperature	Ah	
11	Rated Capacity at maximum ambient temperature	Ah	
12	Capacity in AH at various end cell voltages and duration of discharge		
		<b>E. C. V.</b>	
	5 minutes	1.62	
	15 minutes	1.65	
	30minutes	1.69	
	45 minutes	1.71	
	1 hour	1.75	
	2 hour	1.78	
	3 hour	1.80	
	4 hour	1.81	
	5 hour	1.82	
	6 hour	1.83	
	7 hour	1.83	
	8 hour	1.84	
	9 hour	1.84	
	10 hour	1.85	
13	Open circuit voltage of each battery cell		

	a). Fully charged		
	b). Floating condition		
	c). When completely discharged at i). 10hr. rate ii). 5 hour rate iii). 1 hour rate iv). ½ hour rate v). 1 Minute rate vi). 1 second rate		
14	Maximum momentary current for 1 min till 1.60 e.c.v.		
15	Expected life of battery under normal operation & maintenance conditions	Years	
16	Internal Resistance of each cell (IR)	milli ohms	
	a). at Fully charged condition		
	b). at Fully discharged condition		
	c). at Floating condition		
17	Total Resistance of Battery including inter connectors between the cells	Ohms	
18	Loss in Capacity in 21 hours due to self discharge	%	
19	Recommended Charging rate for		
	a). Float charging i. Limit current ii. Voltage	A V	
	b). Boost Charging i. Starting Current ii. Finishing current iii. Voltage	A A V	
20	Trickle Charging Rate i. Minimum ii. Maximum	mA mA	
21	Equalizing Charge a). Voltage b). Current c). Duration d). Interval between successive equalizing charge	V A Hrs. Months	
22	a). Time to full charge at finishing rate only	Sec	
	b). Time to full charge at higher starting rate	sec	
	c). Time for full charge to charge by two step	Sec	

	charging at starting up and finishing rates		
23	<b>Recommended Specific gravity of Electrolyte at 27deg. C</b> a). for first filling b). at full charge c). when Battery is discharged at 10 hours rate		
24	<b>Permissible max. temperature of electrolyte</b> a). During Initial Charging b). During Normal Charging	deg C deg C	
25	<b>a.Amount of electrolyte and Specific gravity at 27 deg. C</b> for first filling b) Electrolyte conforms to Standard		
26	<b>Overall dimensions</b> i). Each cell L x W x H (tolerance of +/-2mm in each case) ii). Complete Battery	mm mm	
27	Distance between cell centres	mm	
28	Quantity of Electrolyte per cell	litres	
29	Quantity of Electrolyte for battery (including 10% extra)	litres	
30	<b>Weight (+/-5%)</b> Each cell i). without acid ii). With acid	Kg kg	
31	Complete Battery i). without acid ii). With acid	Kg kg	
32	Weight per cell a) Active elements- positive b) Active elements- negative c) Container	Kg Kg Kg	
33	Total shipping weight of Battery units	Kg	
34	<b>Material and type of Plates</b> <b>(i). Positive Plates</b>		
	a). Material and Type		
	b). Height of Positive Plate	mm	
	c). Thickness of Positive Plate	mm	
	d). Area of Positive Plate	Sq.m	
	e). No. of positive plates per cell		
	f). Whether positive plates of individual cells are interchangeable		
	<b>(ii) Negative Plates</b>		

	a). Material and Type		
	b). Height of Negative Plate	mm	
	c). Thickness of Negative Plate	mm	
	d). Area of Negative Plate	Sq.m	
	e). No. of Negative plates per cell		
	f). Whether Negative plates of individual cells are interchangeable		
35	<b>Material and type of Separators</b>		
	a). Material and Type		
	b). Thickness of separator	mm	
36	Clearance between bottom of the plate and the bottom of the container	mm	
37	Clearance between top of the plates and top of container	mm	
38	Clearance between edges of plates and inner surface of container	mm	
39	Sediment space (depth)	mm	
40	Whether explosion vents are offered		
41	a).Type of Vent and Filling Plugs b). Interval of Top-up	In Years	
42	<b>Container</b>		
	a). Thickness of Container	mm	
	b). Material of Container & Type		
	c). Outside dimensions (L x B x H)		
43	<b>Cover</b>		
	a). Type of cover		
	b). Material of cover		
44	<b>Connections</b>		
45	Material of Inter-Cell Connectors		
46	Thickness of Inter-Cell Connections	mm	
47	Method of connection		
48	a). Inter-row, Inter-tier connectors and end take-offs furnished? b). Description, Size, current rating, Type & Material		
49	Connection hardware with 5% extra furnished?		
50	Material of Bolt, Nut and Washer for inter-cell and Cable Connections		

51	Cell insulators provided. If yes, material of insulator	Yes/No	
52	<b>Racks</b> a). Number of racks per battery b). Number of cells per rack c). Type of racks d). Material of rack e). Dimensions of the racks f). Net weight g). Shipping weight		
53	Racks provided with a). Numbering tags for cells b). Insulators c). Whether anti acid coating is provided		
54	Insulator with 5% extra furnished for a). Cell b). Stand		
55	<b>Ventilation requirements</b>		
56	Cubic content of battery rooms	m <sup>3</sup>	
57	Gas generation per single cell per hour	Lit	
58	No. of air exchanges required per hour		
59	Standard Maintenance accessories provided	Yes/No	
60	Gasification Voltage per Cell	Volt	
61	<b>Characteristic Curves (furnish curve numbers and attach separate sheet)</b>		
	i). Charge Hours Vs Volts during Boost mode ii). Discharge hours Vs AH in percent of 10 Hrs. Discharge rate (Capacities at various discharge rates). iii). Capacity Vs Ambient temperature iv). Discharge Rate Vs minimum Discharge Voltage		
62	Curves showing the relation between the specific gravity & amount of charge in the battery for both charging & discharging conditions(whether furnished)	Yes/No	
63	Curves showing the relation between cell voltage & charging current when charged at i) finishing rate(whether furnished) ii). High starting rate iii). Two step charging by starting & finishing rate	Yes/No Yes/No Yes/No	
64	Curve of internal resistance at the end of various discharge rates (Whether furnished)	Yes/No	

65	Recommended Max. period of cell storage before the first Charge (After Installation and filling of Electrolyte)		
66	Recommended Storage life of Battery (dry shelf life)		
67	Does the battery meet the required duty cycle curve	Yes/No	
68	Short circuit current at Battery terminals when a). Float at 2.1 Volts/Cell b). Boost charge to 2.75 Volts/Cell		
69	Time for which the Battery can withstand short circuit at terminals.		
70	Dimensioned layout drawings of the rack & battery to be attached with the tender.	Yes/No	