



June 2007

**TECHNICAL DESCRIPTION TD- 88/1**  
**110 V NICKEL-CADMIUM RECHARGEABLE BATTERIES, FOR 150/20 KV**  
**SUBSTATIONS, HAVING THE 20KV PRIMARY EQUIPMENT INSTALLED**  
**OUTSIDE THE CONTROL BUILDING**

**I. SCOPE**

This technical description covers PPC's requirements with regard to the rated characteristics, design features and testing of 110 V Nickel-Cadmium rechargeable batteries for indoor installation in 150/20 kV substations, having the 20 kV primary equipment installed outside the control building.

**II. KEYWORDS**

Ni-Cd pocket type batteries, discharge rate, vented type batteries, duty cycle, cell, voltage per cell (Vpc).

**III. STANDARDS**

The Ni-Cd rechargeable batteries shall be in accordance with IEC-60623 standard.

**IV. USE**

The Ni-Cd rechargeable batteries shall be used at the 150/20kV substations, having the 20 kV primary equipment installed outside the control building. In case of failure of the AC substation power supply, the necessary DC power supply will be provided by the batteries, which automatically will be put into service, to provide power for all the control and emergency circuits of the substation, e.g. annunciation, indicating lights, protection, emergency lighting and switchgear auxiliary supply. The batteries will be installed indoors, inside a well ventilated area.

**V. OPERATING CONDITIONS**

- |                              |                               |
|------------------------------|-------------------------------|
| 1. Installation              | : Indoors                     |
| 2. Ambient temperature range | : Maximum + 40°C              |
|                              | : Minimum - 10°C              |
| 3. Altitude                  | : Up to 1000m above sea level |
| 4. Relative humidity         | : ≤ 90%                       |

**VI. BATTERIES REQUIRED CHARACTERISTICS**

- |                        |                                |
|------------------------|--------------------------------|
| 1. Type                | : Ni-Cd rechargeable batteries |
| 2. Type of containment | : Vented                       |
| 3. Type of electrodes  | : Pocket                       |
| 4. Discharge rate      | : Medium                       |



5. Nominal Voltage per cell	: 1.2 V
6. Nominal battery output voltage	: 110 V DC
7. Output voltage tolerance of the battery	: -15% - +10%
8. Charging method	: dual rate (floating and fast (boost) with the fast being automatically or manually regulated)
9. Rated capacity (C <sub>5</sub> ) of the battery	: 310 Ah (at 20°C ± 5°C performance fully charged with constant current charging)
10. Duration of discharge	: 8 h
11. Fast recharging time assuming totally discharged batteries:	6 h

## **VII. CELL DESIGNATIONS AND MARKINGS**

Vented Ni-Cd single cells shall be designated by the letter “K” followed by the letter “M”, which signifies medium rate of discharge (M). The letters KM shall be followed by a number which indicates the rated capacity of the cell in ampere hours.

Each cell or monobloc shall carry durable markings giving the following minimum information:

- Type of cell (designation as described above)
- Name of manufacturer
- Positive terminal: bearing either a red washer or an indented or raised symbol. (as indicated in symbol 5005 of IEC 60417)
- Nominal voltage

## **VIII. BATTERY RACK**

The batteries should be supplied complete with all the necessary mounting insulators, stands, end-cell connectors, nickel plated copper lugs, blocks, etc.

For safe and reliable operation, the batteries should be mounted on suitable battery racks of alkali-resistant coated steel rack. The battery rack shall be supplied together with the batteries and should be available in multi-step one tier configuration. Standard battery rack should be supplied in a not assembled condition and should be easily assembled on site. The batteries should be seated on rubber insulators, so as not to have direct contact with the metal rack. The rubber insulators where required shall also be part of the supply.

The dimensions of the supporting steel structure of the batteries shall be as such so that the batteries can be installed in a 3x4m<sup>2</sup> room and so that to be ensured the access to them for checking and maintenance. The batteries are allowed to be mounted perpendicularly to the ground.

## **IX. METHOD OF DELIVERING THE CELLS**



The cells should be delivered empty with the electrolyte in dry form, even the cells which have been used in the tests specified below. Detailed instructions for the right amounts of water needed for the solution of the electrolyte should be provided together with the electrolyte.

**X. TESTS**

The batteries shall be subjected to the following tests as per IEC-60623.

**A. Type Approval Tests**

For type approval the sample sizes and sequence of tests given in Table 1 shall be used. The total number of cells required for type approval is 21. Cells used for testing shall be new cells.

All cells shall be subjected to the tests of group A, after which they shall be divided randomly into four groups of five cells each, denominated B, C and D respectively. This allows one spare cell which permits a repeat test to cover any incident occurring outside the supplier's responsibility. Tests shall be carried out in sequence within each group of cells.

The number of defective cells tolerated per group, and in total, is given in Table 1. A cell is considered to be defective if it does not meet the requirements of all or part of the tests of a group.

**Table 1. Sequence of tests for type approval**

Group	Sample size	Tests	Number of defective cells	
			Per group	In total
A	21	- Marking - Dimensions - Discharge at 20°C	0	2
B	5	- Discharge at +5°C and/or -18°C - High rate currents	1	
C	5	Endurance in cycles	1	
D	5	- Charge acceptance at constant voltage - Charge retention - Electrolyte retention	1	

**NOTE**

Type test certificates for cells of nominal voltage of 1,2 V and of low discharge rate can be accepted in lieu of actual testing.

Manufacturers which have, in the past, supplied batteries to IPTO S.A. of the same characteristics as of the battery of this hereby technical description and are operating satisfactorily, are not required to submit any type test certificates.

**B. Tests for all cables (Routine testing)**



1. Checking of markings
2. Checking of dimensions
3. Discharge testing at 20°C

After charging the cells at a  $20^{\circ}\text{C} \pm 5^{\circ}\text{C}$  and at a constant current of  $0,2I_t$  A for 7h to 8h, the cells shall be stored for not less than 1h and not more than 4h in an ambient temperature of  $20^{\circ}\text{C} \pm 5^{\circ}\text{C}$ . After that, they shall be discharged in the same ambient temperature as follows.

Discharge conditions		Minimum discharge duration
Rate of constant current	Final voltage	Cell designation
A	V	M
$0,2I_t$	1,0	5h

4. Physical appearance

Visual inspection shall be performed on cells. No cracking, damage or corrosion shall be apparent. Any deformation shall be within the tolerances of the dimensions specified in the manufacturer's drawings.

## **XI. DATA WHICH MUST BE SUBMITTED BY ALL BIDDERS**

1. Assembled cell outline drawing together with the appropriate rack, in which all its physical dimensions are clearly depicted (cross section, top view, side view).
2. Dimensions of each individual cell
3. All mounting details and dimensional drawings for the complete installation of the battery.
4. Brochures, technical pamphlets and any other information which is deemed necessary for the technical evaluation process.
5. The number of rows and the number of cells per row.
6. All bidders are required to submit the battery performance charts. These should include discharge data for prolonged float charging in combination with the end-of-discharge voltage per cell, as well as discharge data derived from constant current charging together with the float correction factor for all cases of end-of-discharge voltage per cell. The float charging correction factors should be supplied for specific discharge times and end-of-discharge voltages. The discharge data should be in tabular form, where the current, available from each cell type, should be stated for a given discharge time and end-of-discharge voltage. The float charging correction factors should be supplied for specific discharge times and end-of-discharge voltages.
7. All bidders are required to answer all items of **Attachment A**. Failure to comply or partial filling of the attachment will constitute sufficient reason for rejection of the offer.



8. Spare parts consisting of two cell units and two rubber insulators.
9. Any test certificates for the type tests specified in this hereby technical description and the note of paragraph X.-A  
Acceptance or not of these certificates lies on PPC's judgment.

## **XII. DATA WHICH MUST BE SUBMITTED BY THE SUCCESSFUL BIDDER**

1. Complete physical drawing of the batteries (cross section, top view, side view) for approval prior to construction (3 sets).
2. Maintenance instructions outlining periodical operations necessary for the correct performance and good maintenance of the batteries.

## **XIII. WARRANTY**

The supplier must provide a warranty of two (2) years, beginning from the date of delivery of the batteries, for damages by faulty design, or by unreliable components, or by combination of the two.

## **XIV. PACKING**

The batteries, including their fittings, shall be delivered inside robust wooden boxes.



**ATTACHMENT "A"**  
**110 V NICKEL-CADMIUM RECHARGEABLE BATTERIES**

*All bidders must provide the following data. Failure to comply in full, shall constitute sufficient reason for rejection of the offer.*

1. Type of battery (short description) :.....  
:.....  
:.....
2. Manufacturer :.....
3. Type of electrolyte (short description) :.....
4. Element support (short description) :.....
5. Type of containment :.....
6. Discharge rate :.....
7. Nominal Battery Output Voltage :.....
8. Battery Output Voltage Tolerances :.....
9. Charging Method :.....
10. Rated Capacity of the battery :.....Ah
11. Duration of discharge  
(when battery's fully charged) :.....h
12. End-of-discharge voltage per cell :.....V
13. Number of cells required :.....
14. Internal Resistance of the cell (in fully charged condition) :.....m Ohm
15. Short Circuit Current of the cell and  
of the battery :.....Amps
16. Plate cell thickness :.....mm
17. Plate cell Area :.....mm<sup>2</sup>
18. Cell Weight :.....kg



19. Weight of the whole battery unit complete with electrolyte (without mounting assembly) :.....kg
20. Weight of the whole battery unit without electrolyte :.....kg
21. Thickness of containers :.....mm
22. Material of covers (short description) :.....
23. Thickness of covers :.....mm
24. Total weight of mounting assembly (rack) :.....kg
25. Voltages per cell at 20°C during
  - a) fast charging voltage :.....V
  - b) floating voltage :.....V
26. Required charging time assuming totally discharge battery
  - a) with floating method :.....V
  - b) with fast (boost) method :.....V
27. Is the battery rack part of the supply ? :.....
28. Type of the material and coating of the battery rack :.....
29. Type of the material of the cell insulators :.....
30. Are the cell going to be delivered empty, with the electrolyte in dry form? :.....
31. Indicate the portion of water needed and the portion of the electrolyte for the solution :.....
32. Are the cells marked in accordance with the requirements of paragraph VII? :.....
33. Is the battery supplied with all necessary mounting (cell) insulators, and cell connectors, nickel plated copper lugs, trays etc ? :.....
34. Cell designation :.....
35. Range of ambient temperature during operation :.....
36. Nominal voltage of the cell :.....



- 37. Minimum voltage of the cell :.....
- 38. Maximum voltage of the cell :.....
- 39. Current,  $I_t$ , of the battery :.....
- 40. Current,  $I_t$ , of the cell :.....
- 41. Discharge current available for  
a discharge time of 5h and  
end-of discharge voltage 1,0V/cell :.....