



June 2013

**TECHNICAL DESCRIPTION TD- 86/2**  
**110 V NICKEL-CADMIUM RECHARGEABLE BATTERY FOR 150/20 KV**  
**SUBSTATIONS, HAVING THE 20 KV PRIMARY EQUIPMENT INSTALLED**  
**INSIDE THE CONTROL BUILDING (20 KV METAL CLAD PANELS) AND FOR**  
**400/150 KV OUTDOOR EHV SUBSTATIONS**

**I. SCOPE**

This technical description covers IPTO's requirements with regard to the rated characteristics, design features and testing of 110 V Nickel-Cadmium rechargeable battery for indoor installation in 150/20 kV substations, having the 20 kV primary equipment installed inside the control building (20 kV metalclad panels) and for 400/150 kV EHV substations. In the later case two (2) 110 V batteries are connected in series, in order to create one (1) 220V battery.

**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 IEC60623 standard.

**IV. USE**

The Ni-Cd rechargeable batteries shall be used at the 150/20kV substations, having the 20 kV primary equipment installed inside the control building (20 kV metalclad panels). They shall also be used at 400/150 kV EHV substations, where two (2) 110V batteries will be connected in series, in order to create one 220V battery. In case of failure of the AC substation power supply, the necessary DC power supply will be provided by the battery, 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 battery will be installed indoors, inside a well ventilated area.

**V. OPERATING CONDITIONS**

- |                              |                  |
|------------------------------|------------------|
| 1. Installation              | : Indoors        |
| 2. Ambient temperature range | : Maximum + 40°C |

3. Altitude	: Minimum - 10°C
4. Relative humidity	: Up to 1000m above sea level
	: ≤ 90%

## **VI. BATTERIES REQUIRED CHARACTERISTICS**

1. Type	: Ni-Cd rechargeable cells
2. Type of containment	: Vented, polymer case
3. Type of electrodes	: Pocket
4. Discharge rate	: Low
5. Nominal Voltage per cell	: 1.2 V
6. Operating lifetime at 20°C±5°C	: 20 years
7. Charging method	: dual rate (floating and fast)
8. Rated capacity (C <sub>5</sub> ) of the battery	: 310 – 340 Ah (at 20°C ± 5°C)
9. Type of cells	: KL - P
10. Number of cells per 110V battery, connected in series	: 82 cells
11. Fast recharging time (current limit 0.2xC <sub>5</sub> ) assuming totally discharged batteries	: ≤ 8 h

## **VII. CELL CONSTRUCTION AND MARKINGS**

Vented Ni-Cd single cells shall be designated by the letter “K” followed by the letter “L”, which signifies low rate of discharge (L). The letters KL shall be followed by a number which indicates the rated capacity of the cell in ampere hours and by the letter “P” indicating the polymeric container.

Each cell shall be housed in a separate case of polymer material, in order the replacement of a single cell to be possible. “Monobloc” type with more than one cells is not accepted. The case shall include a flame-arresting vent. The active material of the electrodes shall be housed in pockets, constructed by perforated steel strips.

The vented Ni-Cd cells shall have an expected lifetime of 20 years at least, when they are operating under temperature 20°C±5°C.

Each cell 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 or connecting cables between cells, etc.

For safe and reliable operation, the batteries should be mounted on suitable battery steel racks with alkali-resistant and electrically-insulating coating. The battery rack shall be supplied together with the cells 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 cells 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.

## **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 cells shall be subjected to the following tests as per IEC60623.

### **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 cells (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	L
$0,2I_t$	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 IPTO'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.
3. Detailed instructions for the preparation of the electrolyte and the first filling of the cells.
4. Detailed drawing and instructions for the assembly of the battery rack.

## **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 battery cells shall be delivered in entirely closed and robust wooden boxes of at least 20mm thickness. The electrolyte shall be delivered in separate boxes of the same construction, as above. The rack for each battery will be delivered in a separate box. All boxes will be of "pallet type", with strengthened base.

**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 cells (short description) :.....  
:.....  
:.....
2. Cell designation :.....
3. Number of cells per 110V battery :.....
4. Manufacturer :.....
5. Does each cell have a separate container (not monobloc)? :.....
6. Type of electrolyte (short description) :.....
7. Type of container :.....
8. Nominal single cell voltage :.....
9. Charging Method :.....
10. Rated Capacity of the battery (C<sub>5</sub>) :.....Ah
11. Operating lifetime of the battery at 20°C±5°C :.....
12. Constant current for 8h discharge down to 1.14V per cell, after prolonged float charging of fully charged cells, at 20°C±5°C :.....A
13. Internal Resistance of the cell (in fully charged condition) :.....m Ohm
14. Short Circuit Current of the cell and of the battery :.....A
15. Plate cell thickness :.....mm
16. Plate cell Area :.....mm<sup>2</sup>
17. Cell Weight :.....kg
18. Weight of the whole battery unit complete with electrolyte (without mounting assembly) :.....kg

19. Weight of the whole battery unit  
without electrolyte :.....kg
20. Thickness of containers :.....mm
21. Material of covers (short description) :.....
22. Thickness of covers :.....mm
23. Total weight of mounting assembly (rack) :.....kg
24. Required voltages per cell at 20°C  
a) fast charging voltage :.....V  
b) float charging voltage :.....V
25. Required charging time assuming  
totally discharge battery  
a) with floating method :.....h  
b) with fast (boost) method :.....h
26. Battery rack (short description) :  
:  
:  
:  
:
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. Range of ambient temperature  
during operation :.....