INDEPENDENT POWER TRANSMISSION OPERATOR S.A.
TNPRD/ SUBSTATION SPECIFICATION & EQUIPMENT SECTION

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TECHNICAL DESCRIPTION TD- 87/4
BATTERY CHARGER FOR 110 V NICKEL-CADMIUM RECHARGEABLE BATTERIES, FOR 150/20 KV SUBSTATIONS, HAVING THE 20KV PRIMARY EQUIPMENT INSTALLED INSIDE THE CONTROL BUILDING (20 KV METAL CLAD PANELS)

I. SCOPE

This technical description covers IPTO's requirements with regard to the rated characteristics, design features and testing of a battery charger, for the 110 V Nickel-Cadmium rechargeable batteries, for indoor use in 150/20 kV substations, having the primary equipment installed inside the control building (20 kV metalclad panels).

II. KEYWORDS

Charger, battery charger, Ni-Cd pocket type batteries, thyristor type charger.

III. STANDARDS

The battery charger shall be in accordance with IEC60146-1-1, IEC60142-2, and IEC60529 standards.

IV. USE

The battery charger will be used to provide the necessary power to the substation's D.C. loads under normal operating conditions, and at the same time to provide power for charging the battery which is connected in parallel with the battery charger.

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. REQUIRED BATTERY CHARGER CONFIGURATION (LAYOUT)

The battery charger configuration shall be of the single type and shall be as indicated in Fig No.1 below.

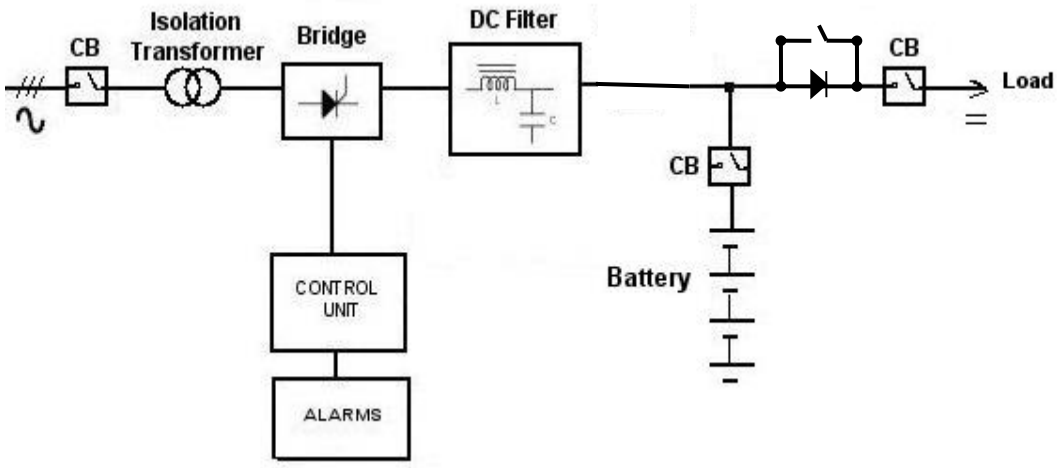

Fig No.1 Battery charger configuration

VII. BATTERY CHARGER REQUIRED RATED CHARACTERISTICS

1. Type	: Thyristor type, consisting of controlled 3-phase full 6-pulse or 12-pulse bridge
2. Nominal Input Voltage	: 400 V AC (3-phase, 3-wire)
3. Input voltage tolerance (steady state) without loss of performance	: ± 10%
4. Input voltage tolerance (short term) without causing trip to charger	: +15%, -20%
5. Nominal input frequency	: 50 Hz
6. Input frequency tolerance	: ± 5 %
7. Nominal output voltage	: 110 V DC
8. Output voltage tolerance (steady state, float charging mode, 0 – 100A output of the charger)	: ± 1% of set voltage
9. Setting of output voltage to the battery during float charging	: 115 – 117 V (116 V preset)
10. Setting of output voltage to the battery during boost charging	: 121 – 139 V (127 V preset)
11. Setting of output voltage to the battery during manual initial charging	: 121 – 139 V (135 V preset)
12. Charging method	: Dual, floating and boost, with IU - characteristic
13. Total rated continuous output current of the charger (battery and d.c. load)	: 100A
14. Output current variation	: 0-100% of the rated value
15. Current limit to the battery ($0.2xC_5$)	: 30 – 100 A (65 A preset)
16. Rated output current to the d.c. load	: 100 A
17. Voltage limit for automatic battery disconnection, at the end of discharge	: 88 – 94 V (90 V preset)
18. Output voltage ripple of charger at 0-100A output, without battery connected	: ± 1 % rms

19. Audible noise level at float charging (1m distance) : ≤ 55 dB(A)
20. Efficiency at rated output current (not including power losses of voltage dropping diodes) : ≥ 87%
21. Harmonics

    The battery charger shall be designed to operate under the following input voltage harmonic values, which include the effect of the battery charger itself (immunity class B):

    a. Input voltage harmonic distortion (THD) : ≤ 10%

    b. Individual input voltage harmonic distortion

    - odd : ≤ 5% of fundamental
    - even : ≤ 2% of fundamental

    At rated current output, the input current shall have following harmonic distortion:

    Input current harmonic distortion (THD) : ≤ 32%
22. Battery characteristics (for information only)

    a. Type : Ni-Cd rechargeable cells
    b. Type of containment : Vented
    c. Discharge rate : Low
    d. Nominal Voltage per cell : 1.2 V
    e. Type of cells : KL
    f. Number of cells, connected in series : 82
    g. Rated capacity : 310 – 340 Ah (at 20^{o}C ± 5^{o}C)

VIII. REQUIRED BATTERY CHARGER OPERATING AND DESIGN FEATURES

1. The battery charger shall be designed for dual charging operation, i.e. for floating and boost, with the boost charging to be automatically and manually selected.
2. If there is a lack of input voltage or voltage out of limits, the load will be automatically fed from battery (battery discharging mode). If the input voltage comes up again, the charger automatically resumes operation and the load is fed through the charger (battery charging mode).
3. In case of an internal fault in the charger (rectifier, controller, dropping diodes, etc), the battery will be connected directly to the load (battery discharging mode).
4. The bridge shall consist of a 6-pulse or 12-pulse controlled thyristor bridge.
5. The battery charger's output voltage leveling shall be achieved by a DC filter, which shall consist of coils and electrolytic type capacitors.
6. During the boost charging, voltage dropping diodes shall be automatically connected between the charger and the d.c. load, in order to keep the voltage to the load within the tolerance ±5% of nominal voltage, with maximum possible load current variation. During the float charging or the discharging of the battery, the diodes will be by-passed through a parallel contactor.
7. The isolation of the battery charger shall be achieved by an input isolation transformer. The transformer and the coils shall have class F or H insulation.
8. The main controller of the charger shall be microprocessor based. It will incorporate all necessary local controls, indications, interlocks and safety features to prevent any false operations and to ensure proper operation. The settings, local controls, indications and measurements shall be provided by a LCD display with a keypad driven menu and by LEDs. A mimic diagram shall be provided, showing in detail the overall system configuration. The alarms and the changes in operating modes of

the charger shall be time-stamped and stored in non-volatile memory. The above will be accessible through the LCD display.

9. All the metal parts of the battery charger shall be earthed. For this reason an earth terminal (copper bar) shall be provided on the charger's enclosure (cabinet) to which all metal parts shall be connected to. The other end of the terminal shall be connected to the earthing grid of the substation.

IX. CHARGING METHOD

The battery charger should be designed to be capable of performing dual charging operation, boost and float charging. The voltage and current to both load and battery will be monitored. Specifically:

1. The charger shall operate according the constant current – constant voltage limiting principle (IU – characteristic) for both charging methods. The output voltage to the battery shall be kept constant at the set value, if the charging current of the battery is below the current limit. If the charging current to the battery reaches the set limit value, then the output voltage shall be reduced, in order the battery charging current to be kept constant at the set limit.

2. During float charging, if the charging current to the battery reaches the current limit, the charger will enter the boost charging mode. This stage provides an accelerated recharging. The boost charging will remain active for a total set time (range 1-24h). After the elapsed time, provided that the battery charging current has fallen bellow the set limit, the charger will revert to the float charging operation. Any alternative method of automatic boost charging initiation must be approved by IPTO.

3. The transition between floating and boost charging mode should be performed automatically. However, the charger should also include the capability for manually starting and stopping the boost charging operation.

4. For the initial charging of the battery during commissioning, an initial charging mode will be selected. The initial charging mode shall be selected only manually. The selection of this mode could be realized, only if the d.c. load is disconnected.

5. When the voltage to the battery voltage falls bellow the set limit at the end of discharge, the battery will be automatically disconnected, in order to protect the battery from deep discharge. The disconnection will be realized through the circuit breaker to the battery or to the load or through an additional contactor, connected in series with the circuit breaker.

X. REQUIRED CHARACTERISTICS OF THE BATTERY CHARGER'S CABINET

A. Cabinet (enclosure)

1. The specified charging equipment shall be housed in an indoor steel cabinet suitable for floor standing.

2. The cabinet shall be accessible from the front via a door. The cabinet can be installed against the wall, because the air openings (louvers) shall be located either on the sides or on the top of the cabinet.

3. The enclosure should provide a degree of protection of not less than IP20 in accordance with IEC 60529. The floor shall not be considered as forming part of the enclosure.

4. Anti-condensation heaters shall be fitted in the cabinet, controlled by a thermostat.

5. The cabinet shall be designed as to allow bottom cable entry. Cables shall enter and exit through cable glands. The glands shall be part of the supply.

6. The cabined shall be electrostatically painted with RAL 7032 color (grey).

7. Terminal blocks shall be provided for all external connections. The output power terminals shall have screw connectors suitable for at least 50mm^2 size conductors. The input power terminals shall have screw connectors suitable for at least 10mm^2 size conductors. The terminals for signalling shall be of the rail mounted type and have screw connectors suitable for at least 2.5mm^2 size conductors.

B. Cooling

Internal cooling of the battery charger shall be by natural air ventilation during float charging. Forced air ventilation is allowed only during boost charging, but is not allowed during float charging. If the voltage dropping diodes are housed in a separate cabinet, the above cooling requirements are applied to both cabinets.

The cabinet shall not incorporate cooling air filters that require periodic cleaning and/or replacement, however it shall contain proper louvers which will ease the natural air circulation.

C. Accessibility and Maintenance

The location and grouping of components and auxiliary equipment within the cabinet (enclosure) shall permit easy identification and access for operational, maintenance and repair purposes.

All live terminals of door-mounted equipment having a maximum (peak) voltage of greater than 24 V shall be shrouded or otherwise protected by barriers (insulating shields) to a degree of protection of at least IP 20.

All bare bus bars, live terminals and components located within the cabinet shall be similarly protected by barriers or shrouds to a degree of protection of at least IP 20.

XI. CONTROL, SIGNALLING, INDICATING AND MEASUREMENT

The digital display with keypad driven menu and LEDs on the front side of the battery charger's cabinet shall include the following:

1. Control functions
a. selecting automatic or manual boost charging operation
b. manually starting or stopping the boost charging operation
c. Manually selecting feeding load through charger (battery charging mode) or feeding load from battery (battery discharging mode)

2. Indicating functions
a. charger is feeding the load (battery charging mode)
b. charger fault
c. battery is feeding the load (battery discharging mode)
d. floating charging is in operation
e. boost charging is in operation
f. mains input voltage is out of limits
g. output voltage towards the load is out of limits
h. earth fault in the DC distribution
i. mimic diagram of the battery charger configuration

Below or above each LED there shall be a proper label indicating the function of each LED. The label shall be legible and of such material as to be time durable (40 years at least) without losing legibility.

3. Measurement functions
a. input voltage
b. output voltage (load and battery side)
c. output current (total and to the battery)

4. Remote signalling
a. charger fault or charger off
b. battery is feeding the load (battery discharging mode)
c. operation in battery float charging mode
d. operation in battery boost charging mode
e. mains input voltage is out of limits
f. earth fault in the DC distribution

The remote signaling will be realized through voltage free auxiliary contacts.

XII. REQUIRED PROTECTION FEATURES OF THE BATTERY CHARGER

1. In the battery charger's cabinet shall be installed at least three (3) automatic circuit breakers.
   - One (1) automatic circuit breaker in the input before the isolating transformer
   - One (1) automatic circuit breaker in the output towards the load side
   - One (1) automatic circuit breaker in the output towards the battery side

2. The battery charger shall be designed to protect itself against the following:
   - Overloading
   - Short circuit
   - Out of limits input voltage (over voltage/under voltage protection)
   - Out of limits output voltage (over voltage/under voltage protection)

3. The charger and the voltage dropping diodes will be protected against overtemperature.

4. The DC distribution will comprise an isolated earthing system and will be monitored for an earth fault.

XIII. RATING PLATE

The rating plate of the battery charger shall be of non-corrosive material and shall bear the following indications.

1. Manufacturers name
2. Type of battery charger
3. Serial number
4. Number of input phases
5. Rated input voltage
6. Rated input current
7. Rated input frequency
8. Output indication: DC
9. Rated output voltage
10. Rated output current
11. Range of output voltage
12. Cooling method during float and boost charging
13. Displacement factor under rated conditions
14. Degree of protection as per IP
15. Overall weight

XIV. TESTS

The charger shall be subjected to the following tests as per IEC 60146-1-1.

A. Type Tests

The following tests will be performed on one (1) battery charger of the order.

1. Insulation tests. Test voltage = 2000V rms
2. Light load and functional test
3. Rated current test
4. Power loss determination for the battery charger
5. Power loss determination for the voltage dropping diodes
6. Temperature rise test
7. Checking of auxiliary devices
8. Checking the properties of the control equipment

9. Checking the protective devices
10. Audible noise test
11. Input power factor measurement
12. Measurement of ripple voltage and current at the output
13. Measurement of input current total harmonic distortion (THD) and individual harmonics

B. Routine Tests

The following tests will be performed on all battery chargers of the order. The cost of performing these tests shall be born by supplier.

1. Insulation
2. Light load and functional
3. Checking of auxiliary devices
4. Checking the properties of the control equipment
5. Checking the protective devices

XV. DATA WHICH MUST BE SUBMITTED BY ALL BIDDERS

All bidders are requested to submit, in their technical offer, the following information.

1. Charger preliminary outline drawing (front & side and bottom view).
2. One line diagram of the battery charger.
3. Preliminary schematic diagram of charger.
4. Description of operation of the battery charger.
5. Declaration from the manufacturer that the offered type can operate with natural air ventilation during float charging. If the charger does not include fans at all, the declaration shall include boost charging operation also.
6. Brochures, technical pamphlets and any other information which is deemed necessary for the technical evaluation process.
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. Any available type test certificates for the type tests of paragraph XIV.A. Acceptance or not lies at the judgment of IPTO.

XVI. ITEMS WHICH MUST BE SUBMITTED BY THE SUCCESSFUL BIDDER

1. Complete physical drawing of the battery charger unit (front view, top view, side view and bottom view) for approval (3 sets) prior to the construction of the battery charger.
2. Detail schematic and wiring drawings of the battery charger (3 sets) for approval, prior to construction.
3. One line diagram of the battery charger (3 sets) for approval, prior to construction.
4. Maintenance instructions in detail.

XVII. WARRANTY

The supplier must provide a warranty of three (3) years, beginning from the date of delivery of the charger, for damages by faulty design, or by unreliable components, or by combination of the two.

XVIII. PACKING

The chargers shall be delivered in entirely closed and robust wooden boxes of at least 20mm thickness. Each box will contain one (1) charger. The boxes will be of ´´pallet type´´, with strengthened base. Inside the box the charger will be additionally protected through nylon wrapping film.

ATTACHMENT "A"

BATTERY CHARGER FOR 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 charger (short description) :.....
   ……...
   ……..

2. Manufacturer :.....

3. Number of phases of input voltage supply :.....

4. Nominal input voltage :.....

5. Input voltage tolerance :.....

6. Frequency of input :.....

7. Input frequency tolerance :.....

8. Nominal input current :.....

9. Nominal output voltage :.....

10. Output voltage tolerance for the d.c. load (steady state, float charging mode, 0-100% output to the d.c. load) :.....

11. Output voltage setting range for the battery (float charging) :.....

12. Output voltage setting range for the battery (boost charging) :.....

13. Total rated output current of charger (battery and d.c. load) :.....

14. Output current variation :.....

15. Rated continuous output current of thyristors in 3-phase bridge :.....

16. Rated output current to the d.c. load :.....

17. Rated continuous current of voltage dropping diodes :.....

18. Current limit setting range to battery :.....

19. Voltage limit setting range
for automatic battery disconnection,
at the end of discharge :.....

20. Output voltage ripple of the charger,
at 0-100% load :.....

21. Total input power factor :.....

22. Efficiency at rated output :.....

23. Noise level :.....

24. Charging method :.....

25. Allowed input voltage
total harmonic distortion (THD) : ……..

26. Input current
total harmonic distortion (THD) : ……..

27. Is the battery charger capable
of float charging? :.....

28. Is the battery charger capable
of boost charging automatically
and also manually? :.....

29. Is a controlled full thyristor bridge
included in the charger? : .....

30. Type of the thyristor bridge
(6-pulse or 12-pulse) : .....

31. Is the battery charger equipped
with DC filter for output voltage levelling? :.....

32. Is the battery charger equipped
with an isolation transformer? :.....

33. Is automatic battery disconnection
available at the end of discharge? :.....

34. Output voltage setting range
for automatic battery disconnection? :.....

35. Is an earthing terminal provided
for earthing all metal parts of

the battery charger? :.....

36. Is the battery charger equipped with a microprocessor-based controller and LCD display? :.....

37. Is accessibility to the battery charger obtained through the front door? :.....

38. Is the battery charger cabinet suitable for floor standing? :.....

39. Indicate the degree of protection as per IP of the battery charger's cabinet :.....

40. Is the cabinet equipped with anti-condensation heaters controlled by a thermostat? :.....

41. Cooling method of the battery charger during float charging :.....

42. Cooling method of the battery charger during boost charging :.....

43. Is the battery charger cabinet equipped with air openings (louvers) on the sides or on that top, for air ventilation? :.....

44. Is the cabinet equipped with air filters? :.....

45. Is the cabinet designed for bottom cable entry or exit? :.....

46. Is the cabinet equipped with cable glands for the cable entry or exit? :.....

.....

47. Method of painting of the cabinet and type of color :.....

.....

48. With regard to the terminal blocks, does the battery charger conform to the requirements of paragraph X.7? :.....

49. With regard to control functions,

does the battery charger conform
to the requirements of paragraph XI.1? :.....

50. With regard to indicating functions,
does the battery charger conform
to the requirements of paragraph XI.2? :.....

51. With regard to measurement functions,
does the battery charger conform
to the requirements of paragraph XI.3? :.....

52. With regard to remote signalling functions,
does the battery charger conform
to the requirements of paragraph XI.4? :.....

53. Is the battery charger equipped with
three (3) automatic circuit breakers
as indicated in paragraph XII.1? :.....

a. Automatic circuit breaker in the input of
the battery charger before the isolating transformer

i. Rated Current :.....

ii. Breaking Current :.....

iii. Set overload current :.....

b. Automatic circuit breaker in the output
towards the load side

i. Rated Current :.....

ii. Breaking Current :.....

iii. Set overload current :.....

c. Automatic circuit breaker in the output
towards the battery side

i. Rated Current :.....

ii. Breaking Current :.....

iii. Set overload current :.....

54. Is the battery charger protected against:

a. Overloading? :.....

b. Short circuit? :.....

c. Out of limits input voltage?
(overvoltage / undervoltage) :.....

d. Out of limits output voltage?
(overvoltage / undervoltage) :.....

55. Is the charger equipped with
DC earth fault monitoring? :.....

56. Type and manufacturer of the
controlled thyristor bridge :.....

57. Type and manufacturer of the
voltage dropping diodes :.....

58. Dimensions of the battery charger (LxWxH) :.....

59. Weight of the battery charger :.....

60. Will the package of the chargers
follow the requirements of par. XVIII
of this hereby specification? :.....