Response to RFIs on Farah substation

ANNEXURE - III

The technical Specifications of batteries and chargers as follows

All bidders may note that the Price schedule item No: A.27 for supply of 220V DC DB in Price Schedule No:1 need not be quoted as this item is included in supply of Battery charger.

Technical Specifications for Batteries

1) **General:** This specification covers the design, manufacture, factory testing, marking, packing, shipping, transportation, installation, site testing and commissioning of 48V and 220V planet type Battery

   The required Battery shall conform in every respect to recognize standards for engineering design and workmanship and shall be capable of performing continuous commercial operation within the parameters guaranteed by the manufacturers and in accordance with the specifications.

   The Battery, to be offered, shall be complete in all respects necessary for their effective and trouble free operation as far as possible.

1.1) **Application Standard Specification:**

   a) IEC 60896-11 General requirements & method of tests for stationary lead acid Batteries.

   b) IEEE-485 IEEE recommended practice for sizing of large lead acid Storage batteries for generating stations and sub stations.

   c) IEEE-484 recommended practice for design and installation of Storage batteries.

2) **TECHNICAL DESCRIPTION:**

2.1) **General Requirements:** The 220V DC Battery systems shall be used to provide the required DC supply for the protection relays, tripping of all feeders & subsequent restoration, local indication, control equipment, emergency lighting and fire fighting (if available) and the 48 V batteries for SCADA and Telecommunication. The Battery to be offered shall be designed to work as indoor equipment (unless else specified).

2.2) **Battery:**

2.2.1) **General:** The DC systems shall comprise battery Bank. The battery bank shall be designed and rated to provide the 100% of the entire load including the planned extension on 10 hour discharge rate basis at the required terminal voltages that maintain the connected equipment to the distribution board operating within the specified regulated voltage limits.
The battery to be offered shall be of the Lead Acid Type (Lead-Plante Type). It shall be designed and rated to work in the prevailing conditions in Farah, Afghanistan.

The number and arrangement of the cells in each battery bank shall be such as to maintain the voltage at the distribution board within the regulated limits over the complete discharge cycle. In the meantime it shall cater for the voltage drop over the whole chain of cables up to the equipment input when the battery alone is feeding the DC load (charger is disconnected).

The battery Bank shall be formed from single cells in order to achieve economical maintenance replacement. The battery cells shall be supplied together with the required quantity of electrolyte for the initial filling at site. The electrolyte shall be free from impurities and dilution of the alkaline electrolyte and topping up of cells shall be carried out using distilled water only.

The containers should be moulded from transparent Styrene Acrylonitrile (SAN) giving excellent clarity, outstanding chemical resistance, rigidity and toughness with very high insulating qualities which eliminate the need for separate cell insulators. It should have adequate Mechanical strength to prevent bulging, cracking etc. during the life span of battery when operating under expected temperature range and due to action of static and dynamic loads and the action of electrolyte.

The positive plates shall be of Plante' lamellare Type. Plates shall be made of 99.99% pure and shall be free from any kind of manufacturing defects. It shall be electro-chemically formed and shall be capable of operating under normal working conditions without buckling of cracking. The positive plates should be cast in a single piece. Welding together of smaller size lead casting/plates to form larger sizes will not be acceptable. It should be genuine Plante' type of plate only and not so called equivalent type. The plates shall be designed for maximum durability during all service condition including high rate of discharge and rapid fluctuation of load.

The negative plates shall be of flat pasted type. It should have adequate mechanical strength and should be so designed that active material is maintained in intimate contact with the grid under normal working conditions throughout the life of the battery.

The separators should be of sintered PVC providing complete diaphragm between the plates. It should be acid resistant, chemically inert and should have excellent oxidation resistance and high degree of porosity to ensure minimum internal resistance. It should not exhibit any tendency to swell or shrink at temperature encountered during operation.

Connectors should be adequately designed to offer minimum impedance. The current carrying area of the connectors shall conform to the requirement of BS 6290 part II 1999. While considering the terminal voltage of the cell at the time of testing for discharge, the voltage drop due to inter-row and inter-cell connectors shall be considered. Connectors shall be of lead plated copper. The lead coating shall be adequate and tenacious. Minimum thickness of lead coating shall be 25 microns. Connectors shall be adequately designed to withstand various stress due to temperature charges, attack of acid and dynamic forces that could occur during the operation of the battery.
The electrolyte shall be battery grade sulphuric acid conforming to latest edition of IEC. Required quantity of electrolyte for the initial filling with 10% extra quantity shall be supplied in non-returnable, non-degradable acid resistant strong plastic containers.

Water use in preparation of electrolyte and also periodic topping up during the course of operation of testing shall conform to the latest edition of IEC standards.

Positive and negative terminal posts of the cells shall be clearly and unmistakably identifiable. Terminal posts shall be designed to accommodate external bolted connections conveniently and positively. The terminal post size should be capable of carrying current so as to conform to BS:6290 part II 1999.

All metal parts of the terminals shall be of lead coated type. Bolts, heads and nuts, except seal nuts, shall be hexagonal and shall be lead covered. Terminal posts shall be adequately fixed or removed. The junction between terminal posts and cover shall be adequately sealed to prevent any seepage of the electrolyte. All terminals shall be provided with insulated covers (Shrouds). The electrolyte performance and the design of the cells shall be such that site inspection and routine maintenance activities, including topping up of the electrolyte, shall not be at short intervals (probably for not less than six months).

The following information shall be indelibly marked on outside of each cell of the Battery:

a) Manufactures name and trade mark.

b) Country and year of manufacture.

c) AH capacity.

d) Upper and lower electrolyte level shall be marked on the transparent containers.

At site each battery cell, upon mounting the entire cells on the battery stand, shall be numbered in a sequence, subject to approval by DABS.

The Supplier/Contractor may furnish any additional technical particulars relevant to the technology of the battery offered.

The bidder shall submit along with their offer the following in Hard and Soft copy.

i) Set of GA Drawing for complete battery sets, battery stand and individual battery cell drawing with sectional view.

ii) Technical literature/Manuals.

iii) Performance curves/write-up on working battery. The data submitted shall be adequate to evaluate the performance/quality of item offered.

iv) The detailed drawing showing the size & quantity of steel sections for stands.

The successful bidder shall submit three sets of following drawing for approval in hard and soft copy.

i) Set of GA Drawing for complete battery sets, battery stand and individual battery cell.
ii) Complete bill of material accessories indicating make, material, quantity, size & type where applicable.

iii) Sectional view showing interior construction of the battery cell. It shall also include the information of C/S area of positive and negative plates, container dimensions, type/grade and quantity of electrolyte.

2.2.2) **Battery Mounting connections and Accessories:-**

The Battery shall be mounted suitably on steel stands of robust construction and in such a way that allows easy access to each cell during maintenance. The stands shall be treated with acid resisting enamel or glossy paint.

The stands shall be mounted on insulators and be so dimensioned that the bottom of the lower tier is not less than 300mm above the floor.

The Battery shall be supplied completely with all necessary connections and cabling. Connections between tiers/between end cells shall be by PVC insulated cables arranged on suitable racking or supports.

The connections between the cells shall be preferably be bolted type. The bolts, the nuts, the connectors etc. shall be effectively lead-coated to prevent corrosion. Torque wrench (insulated), suitable for the battery shall be supplied at free of charge.

Terminal plates of each cell shall be clearly marked as positive and negative. End take-off connections shall be made by single core PVC insulated copper cables.

PVC insulated stranded copper cable shall be supplied for the connection between battery and charger including terminal lugs.

One set of tools comprising two syringe hydrometers, one DC voltmeter having range-3V-0-+3V, ten cell-bridging connectors, one electrolyte-pouring funnels, two electrolyte thermometers, battery instruction card for wall mounting, electrolyte airtight containers, labels, other items necessary for the erection and correct functioning and maintenance of the battery shall be provided with the battery.

2.2.3) **Nameplates, Labels and Marking:-**

The nameplate shall be white with black engraved letters shall be provided for the battery bank. AH capacity, No. of Cells, Name of supplier, P.O. No. etc. shall be provided in the name plate Cell No. shall be marked with suitable stickers.

3) **TESTING AND INSPECTION:-**

3.1) **General:-** Testing of the battery shall be performed in line with this specification and in accordance with the relevant IEC Standards (as minimum requirement) and other Standards as may be approved by DABS.

Acceptance by DABS representative of any unit shall not relieve the manufacturer from any of his performance guarantees or from any other obligations.

Test certificate for each unit shall be submitted prior to delivery of the unit.

DABS reserve the right to perform checks during manufacturing process at any time or all the times. It shall be at the discretion of DABS to witness tests on 100% or any
percentage quantity of each lot for routine tests, apart from the type tests, wherever called for.

3.2) **Factory Tests:-**

3.2.1) **Routine Tests:-**

Routine test certificates shall be submitted for DABS's review and approval before shipment of the Battery.

The battery shall pass all the routine tests as laid down in the relevant IEC /other specified Standard. The visual inspection, which shall determine conformity of the battery shall be part of the routine tests. The proposed routine tests are:

1) Verification of Dimension
2) Verification of marking and packing
3) Test for capacity

Test for voltages during discharge & Ampere-hour efficiency test

3.2.2) **Physical Inspection at Site :-**

a) Checking of properly installed cell terminal coverings.
b) Battery cells are properly installed and numbered.
c) Checking of battery assembly wiring with approved wiring diagrams.
d) Checking of wiring termination and conductor sizes to and from battery assembly.
e) Checking all wire connections to verify that wire connections are adequately tightened.
f) Checking of levelling and alignment of installed battery assembly.
g) Checking of tightness of connection and fastenings and cell links are tight, and use of proper tools.
h) Checking of correct polarity marking is clearly made for each cell and equipment connections.
i) Checking of proper grounding facility.
j) Measurement the continuity of each current carrying connection (MEGGER).
k) Checking of physical integrity of major parts and all instruments and components.
l) Checking of proper battery and cable identifications.
m) Checking of correct circuit fusing.
n) Checking of ratings of all major components and verification equipment's accordance with the specification.
o) Check for cracks and/or solution leakage at battery housing.
p) Check battery electrolyte i.e., level, color and specific gravity.
q) Battery impedance Measurement test.

3.3) **Site Acceptance Tests:**- The tests shall comprise but not limited to following test:
   a) Checking of gravity of the electrolyte and confirmation.
   b) Charging and discharging of the battery bank, as per the standard procedure and confirmation of AH Capacity of the Cells.

**TECHNICAL SPECIFICATION AND CONSTRUCTIONAL FEATURES FOR BATTERY CHARGER**

1) **General:**- The specification covers the design, manufacture, factory testing, marking, packing, shipping, transportation, installation, site testing and commissioning of 220V/48V Chargers. The ampere capacity of the Charger shall be capable of initial, trickle, Boost charging of the 220V, 300AH/48V 120AH Plante type Lead-Acid Batteries.

The required Charger shall conform in every respect to recognize standards for engineering design and workmanship and shall be capable of performing continuous commercial operation within the parameters guaranteed by the manufacturers and in accordance with the specifications.

The Chargers, to be offered, shall be complete in all respects necessary for their effective and trouble free operation as far as possible.

1.1) **Standard to be followed:**- The components of the charger shall comply with existing IEC standards specification, including as amended from time to time.

2) **TECHNICAL DESCRIPTION:**-

2.1) **General Requirements:**- The 220V DC charger systems shall be used to provide the required DC supply for the protection relays, tripping of all feeders & subsequent restoration, local indication, control equipment and fire fighting (if available) and 48V DC for SCADA & Telecommunication systems.

The required charger/distribution board systems shall be designed with following functional blocks integrated in a single unit. One charger

One distribution board for distributing power to the various loads

Each system shall be rated to feed 100% of the entire calculated DC load. The Supplier/Contractor shall provide a comprehensive calculation for the charger capacities considering the worst loading conditions, for DABS approval.
The nominal rating of the DC Supply shall be 220V at DC/48V DC Distribution Board Busbar. The chargers shall be fed through 400V AC, 3-phase, 50Hz (Δ/ Y) system. The charger offered shall be designed to work as indoor equipment (unless otherwise specified)

2.2) **Charger & Distribution Board:-**

2.2.1) **General:-** The battery charger and DC distribution board shall be integrated in a single unit based on the rating. The bidder/supplier shall submit GA drawing along with the tender.

The battery charger shall be designed for float mode and boost mode. It shall be suitable for initial charging of Lead Acid, Plante type Battery. The battery charger shall be capable of continuous operation to feed the 100% load plus charging the corresponding battery bank, either on float or on boost charging modes. The cubicle shall be an indoor, floor-mounted, self-supporting sheet metal enclosed cubicle.

All necessary base frames, anchor bolts and hardware shall be part of cubicle fixing. 3.0mm thick sheet shall be used for load bearing parts and 2.0mm thick sheet shall be used for other parts of the charger. Type of cooling shall be natural air cooled/forced air cooled as per the design requirement. Heat dissipation and temperature rise calculation inside the cubicle of the charger shall be submitted for the approval of the KSE Board. For forced air cooling system, suitable louvers with filters shall be provided.

Removable gland plates shall be provided in the cubicle. The lugs for power cables shall be made of electrolytic copper with tin coat. Power cable sizes shall be defined based on calculation for the voltage drop over each stage and accordingly the suitable cable lugs and drilling of gland plates shall be defined.

The cubicle shall be vermin proof. Ventilation louvers shall be backed with air filter. Cooling fans shall be provided as specified above. Fan failure alarms shall be provided, wherever applicable. All doors and covers shall be fitted with synthetic rubber gaskets of good quality.

The cubicle shall have hinged double leaf doors at the backside and hinged single leaf front door (2 Nos.) i.e, cubicle shall have both front and rear end openings for adequate access to the inside components. All indicating instruments, control switches and indicating lamps shall be mounted on the inner front door of the cubicle. Front outside door shall be provided with polycarbonate sheet window to view the equipments installed in the inner front door,
from outside. The cubicle doors shall be properly earthed. The degree of protection of charger cubicle shall be at least IP-42.

The control wing shall be PVC insulated, fire retardant (1.1kV) of at least 2.5mm² stranded copper wires. Control terminals shall be suitable for connecting two wires, with 2.5mm² stranded copper conductors. All terminals shall be numbered for ease of connections and identification. Each wire shall bear a ferrule or tag on each end for identification. At least 10% spare terminals shall be provided for control circuits.

The insulation of all circuits except the low voltage electronic circuits shall withstand test voltage of 2 kV AC for one minute.

AC and DC switches shall be provided at the input and output respectively with adequate rating. The operating handle of the switch shall be fully insulated.

The charger failure device shall detect the AC supply voltage failure. The detecting device shall not operate on switching surges or transient loss of voltage due to faults on the power system. In addition, the charger shall be equipped with a 4 pole MCB and contactor at the input and fuses and an off load isolator at the DC output. A suitable single phasing detection shall be provided for the AC input. The relay shall initiate necessary alarms for single phasing.

The battery charger shall be provided with facility for both automatic and manual control of output voltage and current. It shall have current limiting facility, if the voltage control is in an automatic mode and shall cause a gradual lowering of the output voltage when the DC load current exceeds the load limiting setting. The current limiting characteristics shall be such that any overload or short circuit in the DC system shall neither damage the charger, nor cause blowing of any of the charger fuses. The charger shall have an adjustable current limiting facility, also for safe guarding the Battery. The charger shall not trip for overload or external short circuit. Soft start feature should be invariably provided to minimize the in-ruah current.

Uniform and smooth adjustments of voltage setting (in both manual and automatic modes) shall be provided. During boost charging, the battery charger shall operate on constant current mode (when automatic regulator is in service). It shall be possible to adjust the boost charging current continuously over a range of 50 to 100% of the rated output current for boost mode. During float mode, the charger shall be on constant voltage mode with battery current limiter. During boost charging, DC output from charger shall be
within specified limit. For achieving this, suitable battery tap selection with adequate contactors and blocking diode shall be provided.

For limiting the output voltage of the charger, a potentiometer shall be provided, whereby it shall be possible to set the upper limit of the boost voltage as per specified value.

The charger shall be able to recharge the battery after a complete discharge cycle, i.e., to 95% of its capacity within a time interval of not more than 10 hrs and in the mean time supply the entire equipment design load.

Suitable filter circuits with fuse failure alarms shall be provided in the charger to reduce as much as possible the ripple content and also to suppress noise in the output voltage irrespective of the DC load, especially when the battery is not connected to the charger. The charger output voltage (battery disconnected from the charger) shall be free of noise by providing noise filters.

The input of the charger shall be equipped with a device, which shall cause the charger to switch off in the event of DC output over voltage short circuit at the charger shall not cause any damage to the charger from the battery side.

The construction of the charger shall ensure easy access to all components for smooth and safe maintenance.

AC and DC Voltmeters and ammeters (with shunt) shall be provided for the charger, at the input and output correspondingly. The instruments shall be flush type, dust proof and moisture resistant. The instruments shall have easily accessible means for zero adjustment. A low range Ammeter (0-5) A with push button shall be provided to measure trickle charging current in float operation.

All fuses for the protection of outgoing DC circuits shall be HRC type. Rectifier unit shall be protected with semiconductor fuses in AC & DC side with fuse failure alarms. Fuses shall be mounted on fuse holders mounted on fuse bases. The design of the charger shall not allow any reverse current flow from the DC battery into the charger.

The rectifier shall be for three phase half controlled bridge circuit using 3 diodes and 3 thyristors.

2.2.2) **Distribution Board:-** At the output, the 220V DC/48V DC distribution boards shall comprise DC MCBs at the output to feed all various equipment. All DC MCBs shall be connected to the DC Susbar in the panel. The output of MCSs shall be terminated in suitable bolted type terminal connectors. The cables between MCBs and terminal block shall be selected at suitable rating.
Single core, 70 sq mm PVC insulated unarmoured flexible stranded copper cable with suitable lugs (as required) shall be offered along with 220 V Battery charger and 35 sq mm for 48V charger.

2.2.3) **Devices on the Instrument Panel:** The following devices shall be furnished and mounted on the instrument panel of the chargers.

a) MANUAL-AUTOMATIC change-over switch.

b) Boost/Float Selection Switch.

c) DC Leakage detector: Centre "0" DC Analogue meter with E/F detector Alarm.

d) One AC voltmeter for reading the AC input supply voltage with selector switch.

e) One AC ammeter for reading the AC input current with selector switch.

f) Three DC voltmeters with suppressed zero (one for the charger output, one for the battery voltage and one for the load voltage)

g) Four DC ammeter, (one for the charger output current, one for the battery current bi-directional and one for the load current and one for trickle charger) with externally mounted shunt as applicable.

h) Potentiometer shall be provided for current control and voltage control in float and boost modes separately.

I) Battery disconnecting device with auxiliary switch as per specification.

2.2.3.1) **Alarms and Indications:** The following LED indications shall be provided in the charger and distribution panel to announce and monitor the following events respectively: Test, accept, reset facility shall be provided. Alarm shall be triggered at every event of faults. (Irrespective of persisting alarm)

1) Push button for all LEDs testing.

2) Charger supply on.

3) Supply main failure.

4) Rectifier failure.

5) Charger, fuse/MCB trip.
6) DC output high.

7) DC output low.

8) Charger on boost mode.

9) Battery earth leakage.

10) AC Under voltage and over voltage.

11) Battery isolator open.

12) Output DC filter fuse failure.

13) Single phasing alarm.

14) Fan failure alarm.

All alarms shall be wired up to Terminal Block. Item Nos. 4,6,7 and 12 shall be grouped and provided with a potential free contact for remote monitoring. One potential free contacts shall be provided for 8, for remote monitoring.

2.2.3.2) **Protection and control System:-** The charger shall be equipped but not limited to the following protective and control devices:

a) Charger shall be self-protected against high transient over-voltages in DC and AC control and power circuits. The protection shall be built into the equipment and no special external connections, configuration of leads or connections of any external equipment shall be required.

b) Protection against discharge of the battery into the battery chargers upon failure of AC supply, with automatic resumption of pre-set charging rate when power is restored.

c) Single Phasing Prevention (all three phases if a three-phase unit is specified)

d) Low DC voltage relay.

e) DC over-voltage relay.
f) Any failure of the charger, detected by any of these alarms, or protective devices shall be indicated locally, either by lights, or on the front of the rectifier and on local annunciation panel. These alarms shall be possible for grouping in one common alarm for remote transmission.

g) Forced air cooling system failure alarm shall be provided if such a cooling system is used.

h) Terminal blocks: Nut & Bolt type shall be used.

2.2.4) **Noise Level**: The level of the noise generated by the charger equipment, which is supplied under this specification, shall meet requirements as specified in the Guaranteed Technical Particulars (62dB).

In case the maximum level of the sound exceeds the specified allowable value, the Supplier/contractor shall use acoustical treatment features, subject to review of DABS and acceptance, to achieve the sound control design objectives.

2.2.5) **Nameplates, Labels and Marking**: The nameplate shall be white with black engraved letters. On top portion of each battery bank and charger, on front as well as rear sides, larger and bold nameplates shall be provided to identify the charger. Nameplates with full and clear inscription shall also be provided on and inside of the panels for identification of various equipments and ease of operation and maintenance.

2.2.6) **Painting/Corrosion Protection**: All sheet steel work shall be phosphated in accordance with IEC Standards Oil, Grease and dirt shall be thoroughly removed by emulsion clearing. Rust and scale shall be removed by picking with diluter acid followed by washing with running water, rinsing with slightly alkaline hot water and drying. After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed stowing type zinc chromate primer. The first coat may be "Lush dried" while the second coat shall be stowed. After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stowing. The second finishing coat shall be applied, after inspection of 1st coat of painting. The exterior paint colour shall be RAL7032. The interior colour shall be white. Each coat of primer and finishing paint shall be of a slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the panels.
2.2.7) **Interior Lighting and Receptacles:-** Each panel shall be provided with a fluorescent lighting fixture rated for 240 Volts, single phase, 50 Hz supply for the interior illumination of the panel during maintenance. The fittings shall be complete with switch fuse unit, panel door switch etc. for the automatic switching of the fitting. Each panel shall be provided with 240V, single phase, 50 Hz, 5A, 3 Pin receptacles with switch. This shall be mounted inside the panel at a convenient location.

2.2.8) **Earthing:-** The charger panels shall be equipped with an earth fixed along with inside base of panel. The materials and sizes of the bus bar shall be at least 50 x 6 mm tinned copper flat unless specified otherwise. Provision shall be made on the earth bus bars of the end panels for connecting to purchaser's earthing grid. Necessary terminal clamps and connectors for this purpose shall be included in the scope of supply. All metallic cases of relays, instruments and other panel mounted equipment shall be connected to the earth bus by independent copper wires of size not less than 2.5 Sq. mm. The colour of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connections and soldering shall be permitted. Earthing pad of minimum size 30x30mm shall be provided on the side of the panel.

3) **TESTING AND INSPECTION:-**

3.1) **General:-** Testing of the battery charger shall be performed in line with this specification and in accordance with the relevant IEE Standards (as minimum requirement) and other Standards as may be approved by KSE Board. The battery charger system shall be subject to inspection and test by DABS.

Acceptance by DABS's representative of any unit shall not relieve the manufacturer from any of his performance guarantees or from any other obligations. Test certificates for each unit shall be submitted prior to delivery of the unit.

DABS's reserves the right to perform checks during manufacturing process at any time or all the times. It shall be at the discretion of DABS to witness tests on 100% or any percentage quantity of each lot for routine tests, apart from the type tests, wherever called for.

Zero of Earth Leakage Meter shall be earthed. Both sides shall be 110V (24V for 48 charger)
3.2) **Factory Tests:-**

3.2.1) **Type Tests:-** The battery charger system/equipment shall be fully type tested. These tests shall include all type tests as defined in the relevant latest IEC recommendation (as a minimum requirement), including capacity test as per IEC 60896-11. Type test shall include No load test, insulation test and temperature rise test.

Evidence shall be given that the battery charger under these specifications, have successfully passed all type tests of design, service frequency, impulse, insulation level, dynamic operating range, and electrical and mechanical endurance performance, as appropriate and as specified.

However, if deemed necessary, DABS shall decide if additional special tests are required to be performed by the Supplier/contractor. The Supplier/contractor shall supply certified copies of type test certificates covering the proposed battery chargers of similar operating range, data features, design and construction.

An internationally recognised laboratory/NABL approved laboratory shall certify the type test reports.

Type tests certificates/reports shall be considered acceptable if they are in compliance with the relevant Standards and the following:

1) Type Tests conducted at an internationally recognized laboratory acceptable to DABS.

2) Type Tests conducted at the manufacturer's laboratory and witnessed by representatives from an internationally recognized laboratory acceptable to DABS.

If the presented type test reports are not in accordance with the above requirements, DABS may decide to ask for the type tests to be carried out in the manufacturer's premises or other places subject to the approval of DABS at no additional cost, and in the presence of an internationally recognized laboratory who should issue the relevant type test certificates upon successful test.

3.2.2) **Sample Tests:-** Sample Tests shall be performed, comprising as a minimum the following tests.
1) Visual checks and measurements of dimensions.
2) Battery Charger labeling as per this specification.
3) Functional tests.

3.2.3) **Routine Tests:**

The Supplier/Contractor are required to carry out routine tests on each assembled and finished charger system to demonstrate the integrity of the DC Supply system.

Routine test certificates shall be submitted for DABS's review and approval before shipment of the charger.

The battery charger shall pass all the routine tests as laid down in the relevant IEC/other specified Standard. The proposed routine tests are:

1) Visual inspection to determine conformity of the battery charger.

2) Insulation resistance test (HV test)

3) Voltage regulation check from 0 to 100% load with +10% voltage variation in all modes of charging.

4) Ripple content measurement.

In addition to the standard routine tests on the charger, the following tests shall be performed:

Load test
Automatic voltage regulator operation
Performance test on the completed panel
Surge withstand capacity test
Load limiting feature
Efficiency of the charger at full load
Sensitivity of Ground fault protection cards

3.2.4) **Special Tests:** The following test shall carried out in addition to what has been stipulated in the IEC Standard:

Ripple Test (with and without battery)
Noise measurement
High voltage test on power and control circuits
3.3) **Acceptance Tests :-** The tests shall comprise but not limited to the following test:

3.3.1) **Physical Inspection :-**

a) Checking of the battery charger cabinet interior to verify clearances between live electrical parts, insulation of phase and neutral buses from cabinet, and tightness of all mechanical connections.

b) Checking of main breaker trip element dimension and ratings at the battery charger cabinet shall be performed and comparison with the approved wiring diagrams.

c) Checking the operation of the main breaker by application open- close- open sequence manually.

d) Checking of wiring termination and conductor sizes.

e) Checking of tightness of connection and fastenings, and use of proper tools.

f) Checking the correct phasing of equipment connection.

g) Checking the proper grounding.

h) Checking of all current carrying connections, including bus connections and wiring, as installed by Supplier/Contractor, in agreement with wiring drawings.

i) Checking of physical integrity of major parts and all instruments and components.

j) Checking of proper battery charger cabinet and cable identification.

k) Checking the correct circuit fusing

l) Checking the ratings, dimensions, protection class of all major components, as panels, cubicles, silicon rectifiers, buses, circuit breaker, fuses, relays, transformers, etc. and confirmation that the equipment complies with the specification. Any non-compliance shall be reported to the Contracting Officer.
3.3.2) **Tests:-**

a) Polarity check.
b) Proper settings and calibrations.
c) Meter calibration and operation.
d) Functional check of all alarm circuits including low voltage, ground detection and AC failure.
e) Insulation resistance test.
f) Output ripple test.
g) The ability of the charger to maintain this desired operating voltage level.
h) Testing of breaker trip settings.
i) Measurement the continuity of each current carrying connection by Insulation Tester.
j) Testing the changing output voltage function by disconnected battery.
k) Testing the quick charge and trickle charge mode.
l) Testing the charging current limiting (maximum current) by short-circuited DC output.
m) Testing of automatic periodic dis-charging/re-charging.
n) Testing the Battery Charger inputs/digital outputs and control (LED's) and protection functions at/from the Battery Charger Board.
o) Testing the Battery Charger inputs/digital outputs, alarm indications (LED's) and fault monitoring at the Battery Charger Board.
p) Measurement of Voltage Regulation.
q) Efficiency of the charger at full load.
r) Sensitivity of Ground fault protection circuits.