



Exploration & Production

GENERAL SPECIFICATION

ELECTRICAL

GS ELE 151

DC Uninterruptible Power Systems

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1. Scope

This specification covers basic requirements for design, manufacture, operation and testing of stationary batteries, battery chargers and DC distribution panels.

The batteries and chargers will supply DC control power for switch gear, instrumentation and telecommunication systems, and/or emergency or essential services.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Stationary batteries, battery chargers and DC distribution panels shall conform in design, material and performance with the appropriate sections of the latest editions (with amendments) of the relevant IEC, CENELEC standards and codes.

The following order of precedence applies specifically to electrical equipment:

- Applicable laws and regulations of the country in which the system will be operated. In cases where no "local" regulations exist, the French laws and regulations shall be used.
- COMPANY Particular Specifications and data-sheets (if any)
- COMPANY General Specifications
- Applicable International Electro-technical Commission (IEC) Standards
- Applicable European Standards by CENELEC
- Applicable recognised standards and codes (UTE-NFC, BS, VDE, etc.) when IEC publications have not yet been issued

Standards

Reference	Title
IEC 60079	Electrical apparatus for explosive gas atmospheres
IEC 60146	Semiconductor converters
IEC 60255	Relays
IEC 60269-1	Low voltage fuses
IEC 60326	Printed Circuits
IEC 60335-2-29	Safety of household and similar electrical appliances, battery chargers
IEC 60439	Low voltage switch gear
IEC 60529	Degrees of protection of enclosures
IEC 60622	Sealed nickel-cadmium rechargeable cells
IEC 60623	Vented nickel-cadmium prismatic rechargeable single cells
IEC 60726	Power transformers - Dry type
IEC 60896	Stationary lead-acid batteries

Reference	Title
IEC 60947	Low voltage switch gear and control gear
IEC 60993	Electrolyte for open nickel-cadmium element
IEC 61204	LV Power supply with DC output characteristics and safety requirements
IEC 61434	Secondary cells and batteries containing alkaline or other non-acid electrolytes - Guide to designation of current in alkaline secondary cell and battery standards
IEC 62262	Degrees of protection provided by enclosures for electrical equipment against external mechanical impact (IK code)
EN 50014	Electrical apparatus for potentially explosive gas atmospheres
EN 50272-2	Safety Requirements for Secondary Battery and Battery Installations – Part 2 : Stationary Battery

Professional Documents

Reference	Title
Not applicable	

Regulations

Reference	Title
73/23/EEC	European Directive for Low Voltage Equipment
89/336/EEC	Directive on the approximation of the laws of the Member States relating to electromagnetic compatibility
92/31/EEC	Council directive amending Directive 89/336/EEC
93/68/EEC	Council directive amending Directive 89/336/EEC, 73/23 EEC...
94/9/EC (ATEX 100a ¹ / ATEX 95 ²)	European Directive 94/09/EC (23/03/94) on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres
1999/92/EEC (ATEX 118 ¹ / ATEX 137 ²)	European Directive 1999/92/EEC (16/12/99) on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres.

¹ Reference to Articles 100/118 of the Treaty of Rome.

² Reference to Articles 95/137 of the Treaty of Amsterdam.

**Codes**

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS SAF 216	Area classification

3. General**3.1 Environmental data**

The equipment shall be installed inside an air conditioned technical room, with an average ambient air temperature of 25°C but shall be able to operate on unusual condition such as specified in the project data sheets.

In case H₂S might be present in the technical room, as specified in the project data sheet, special provision shall be taken by the MANUFACTURER to avoid equipment/material corrosion. The MANUFACTURER shall indicate the proposed protection measures in his bid.

3.2 Reliability

Reliability of equipment to perform continuously is essential. Prototype or unproven equipment not having a well established operating record will not be considered.

The MANUFACTURER shall state in his bid the availability, reliability and Mean Time Between Failure (MTBF) data for similar units in service.

3.3 Deviations to specification

The MANUFACTURER shall advise the COMPANY of any deviations made in respect of this Specification at the time of tendering. Should this Specification conflict with requirements of the listed standards the MANUFACTURER shall request clarification from the COMPANY.

3.4 Modes of operation

Basically there are two types of DC sources depending on the kind of consumer to be fed :

3.4.1 Type 1

This one comprises one battery (type of battery to be dependent on application) and one charger which is suitable only to feed a single consumer that does not entail safety of persons or equipment in case of loss of supply (e.g. starting batteries), etc.

3.4.2 Type 2

This one comprises two batteries and two chargers in parallel operation through blocking diodes, which is suitable to feed single or multiple consumers that could entail safety of persons or equipment in case of loss of supply.

Depending on the type of battery selected and on the sizing of each battery the second type of DC source can correspond to the following different arrangements:

- Type 2A : Two batteries each 50 % rated shall be used if vented nickel cadmium cells are selected
- Type 2B : Two batteries each 50 % rated shall be used if sealed nickel cadmium cells are selected
- Type 2C : Two batteries each 100 % rated shall be used if vented lead acid cells are selected.

Selection between type 1, 2A/2B/2C or other types shall be indicated in the “project” particular specification, or in the data sheets.

4. Construction requirements

4.1 Cubicles

Batteries, with gas recombination rate equal to or greater than 92% in charge mode and all battery chargers shall be completely assembled and wired in free standing sheet steel cabinets suitable for indoor operation. Battery cubicle shall be properly ventilated, either natural or forced ventilation to avoid gas accumulation. Fan units shall be category 2 as per ATEX directive 94/9/EC.

For redundant DC UPS, separate cabinets shall be provided for each battery charger (and associated batteries when installed in cubicle).

The equipment shall be arranged such that internal access can be made without shutting down. The cabinet shall be arranged for front operation and maintenance. Removable side panels may be provided, but rear access shall not be required. Warning labels shall be fitted in prominent positions advising care to be taken when gaining access to live equipment.

Access doors shall be lockable with a provided common key. They shall be fitted with an internal pocket suitable for a complete drawing set. Easy access shall be provided for topping up batteries in position.

Cabinets shall have at least IP21 protection degree and IP20 when doors are open.

Unless otherwise specified, the cabinets shall be cleaned, primed and painted according to Manufacturer's standard.

The cubicles shall be designed to be lifted by use of detachable eye bolts.

Adequate ventilation shall be provided in order to guarantee the proper operation of the equipment at rated conditions, whatever the mode of operation and the autonomy. Where natural air convection is not practical, redundant forced air cooling might be considered provided that air intakes are fitted with large air filters to allow for long operation without cleaning. Fan motor shall be individually protected (multi-pole switching) and controlled.



In the case where forced cooling is required when the AC supply is not available, the fan motors shall be fed from the battery and the related load taken into account in the sizing of the battery.

The maximum voltage drop in main power cables between remotely located batteries and main equipment cubicles shall be limited to 1 % unless otherwise specified.

4.2 Internal wiring

Internal wiring shall be PVC insulated 1000 V grade, flame retardant, stranded copper conductors, except for connection on printed circuits.

Cabling between components shall be continuous, joining of cables is not permitted.

Internal wiring within the board shall be securely held in position (either loomed or run in trunking).

Wiring identification shall be by numbered and/or lettered ferrules, of insulating material and located adjacent to the terminals.

Wiring connections for external connections shall be brought out to individual terminals on a readily accessible terminal block. Wires shall be terminated using compression type lugs or crimp sleeves.

4.3 Cable termination

External cable terminating facilities and terminals shall be suitable for the specified cable type and conductor size. Cable supports shall be provided by the MANUFACTURER to avoid undue strain on the cable termination. The number of conductors connected to each terminal shall not exceed two for internal cabling and one for external cabling.

Power and control external cabling and relevant terminals shall be fully segregated and separated. Protection covers shall be split in order to provide independent access to power and control terminals.

4.4 Earthing

An earthing busbar shall be provided along the full length of the equipment structure with provision for earth cable connections at each end. All metallic non-current carrying parts of the equipment shall be bonded together and connected to the earth busbar. All doors shall be bonded to the main structure by means of a flexible copper connection arranged so that it cannot be trapped as the door is opened or closed.

5. Batteries

5.1 Battery type

The batteries shall be of one of the following types in accordance with IEC standards and the final cell type selection shall be indicated in the "Project" particular specification or data-sheet.

MANUFACTURER shall provide cell type certification by a recognised Certifying Authority in his bid.

5.1.1 Type A: Vented type nickel-cadmium cells

This type of cell shall have a minimum of 60% gas recombination rate in floating mode. When used for the second type of DC source each of the two batteries shall have a capacity of 50 %. End of discharge voltage shall not be lower than 1.0 V per cell at 20°C.

5.1.2 Type B: Sealed gas recombination type nickel-cadmium cells

This type of cell shall have a gas recombination rate equal to or greater than 95 % in any charge mode. When used for the second type of DC source each of the two batteries shall have a capacity of 50 %. End of discharge voltage shall not be lower than 1.0 V per cell at 20°C.

5.1.3 Type C : Vented type lead-acid cells

No gas recombination in floating mode is required for this type of cell.

End of discharge voltage shall not be lower than 1.80 V per cell at 20°C.

5.2 Battery construction

Vented battery cells shall be assembled in flame retardant heat resistant, shock-absorbing plastic containers with covers attached to form a permanent leak-proof seal. Each containers shall provide visual indication of electrolyte level with level lines marked on front side.

For all batteries type, covers shall be sealed against leakage of electrolyte and shall be fitted with spray-proof vent plugs.

5.3 Battery installation

The battery installation shall be as indicated in the data sheet.

5.3.1 Outdoor Installation in hazardous area

Batteries shall be installed in suitable certified battery boxes and adapted to the battery type.

5.3.2 Battery stands

The stands shall be supplied by the battery manufacturer and made of electrolyte resistant steel or suitably treated wood.

5.3.3 Battery cabinet

Battery cabinet shall be fitted with cell racks mounted on electrolyte resistant sliding frames complete with stoppers. Mechanical interlock shall be provided to prohibit withdrawal of more than one cell rack at a time.

Each sliding rack shall be carefully connected to the main earth busbar by means of flexible copper connections.

5.4 Operating duty

During normal operation, the battery will be "floating" on line with the battery charger maintaining the battery in the fully charged condition, and at the same time supplying the normal steady state loads.

The batteries shall have the capacity to supply loads according to the provided load profile and relevant autonomy defined in the data-sheet with the battery charger being off, without discharging the battery below the cell end of discharge voltage defined in section 5.1.

5.5 Battery terminals

All cell terminals shall have adequate current carrying capacity. Cell terminal posts shall be equipped with connector bolts. Cell terminal posts, bolts, interconnecting links and associated hardware shall be of electrolyte-resisting material and protected by insulating screens to prevent risk of contact with live parts.

5.6 Battery capacity

A load curve versus time shall be provided by ENGINEER/CONTRACTOR to allow definition of battery rating. Also minimum voltage at the end of discharge shall be defined.

An appropriate de-rating factor for ageing (20% minimum) shall be considered for battery sizing.

The MANUFACTURER shall provide at the tender stage a calculation note justifying :

- the type and reference of the battery selected
- the number of elements
- the ageing factor accounted for.

6. Battery chargers/rectifiers

6.1 Electrical service conditions

All equipment shall be rated for continuous operation, with variations of voltage and frequency as stated hereafter:

- AC supply voltage: +10 % -10 %
- Frequency: +5 % - 5 %

The performance of the equipment shall not be affected by :

- Transient voltage depressions down to 80 % of rated voltage.
- harmonic voltage and current up to 20 %.

Unless otherwise stated in the data-sheet, the chargers shall be fed from two different three phase AC supplies with highly impedant neutral and insulation monitoring by low frequency current injection and fitted with differential protection.

All equipment shall meet the requirements of IEC and CENELEC regarding Electro-Magnetic Compatibility (EMC).

6.2 Battery charger operations

a) Chargers shall have two automatic modes of operation: "charge", "float".

When required in project data-sheet, an automatic "battery test" function shall be provided.

Automatic pre-set parameters shall be easily adjustable. Nevertheless, access to such parameters shall be limited to authorised operator via key and/or password.

Facilities shall also be provided to manually initiate all modes of operation but the return to safe operation for the battery shall always be automatic.

The rectifiers shall be protected from over temperature by thermal switches which will de-energise the charger and initiate an alarm.

A loss of control caused by a failure shall block the rectifier bridge.

The charger shall be capable of limiting the output current at its rated value and of limiting the battery charging current to the safe value corresponding to the mode of operation and battery manufacturer's requirements.

The chargers shall be designed not to disturb the AC supply differential protection.

Facilities shall be provided to inhibit the charge mode in case of failure of the battery room ventilation system. If the ventilation failure occurs during the charge mode the chargers shall revert to float mode. Charge mode shall be automatically initiated upon restoration of AC power after an outage. An adjustable timer started when the battery reaches the second stage of charge shall automatically reset the charger to the float mode to prevent the battery from being overcharged. A voltage free contact for remote indication or charge mode status shall be provided.

Float voltage shall be adjusted automatically depending on the battery temperature monitored by a probe. Battery temperature shall be displayed.

Battery test shall be automatically initiated every week or, such as specified in the Project data sheet, to check battery condition and stored energy. During this test, the charger's voltage reference will be reduced and the voltage of both batteries will be monitored. If the battery voltage falls too low, an alarm is generated. In all cases at the end of the test, the chargers return to float or charge mode.

- b)** Chargers shall be able to operate in parallel. Blocking diodes in the positive lead shall be provided as well as automatic load sharing circuitry to proportion the load within 10 %.

An manually controlled isolating switch with interlocking contacts shall be provided to allow,, in case of failure of one charger and after manual operation, charging of both batteries in float or charge mode from the remaining charger. In this last mode it is acceptable that the recharge time be extended.

- c)** Another switch shall be provided to permit an off-line full discharge battery test of each battery at a time on an external load bank connected to extra terminals located in the charger cabinet close to the battery connection terminals.

During this annual test the two chargers and the remaining battery shall continue to supply the load. An auxiliary contact shall be provided for local and remote indication of battery isolated condition.

- d)** When required, A circuit breaker with overcurrent protection only and an undervoltage tripping coil shall be provided for ESD purpose in an EEx "d" IIB T3 enclosure located close to each battery. "Reset" of this breaker shall be possible by an "externally accessible" operating handle. The terminals for the external load bank connection described above shall be arranged so that the EEx"d" circuit breaker is in use during the full discharge test.

6.3 Battery charger characteristics

The charger rating shall be adequate for the normal operating duty, and for charging the battery from "Discharged" to a state of charge (approximately 85 %) which will provide for repetition of the duty cycles described in Chapter 6.2 after eight hours of charging, with steady state load connected.

The charger shall be capable of maintaining the output voltage within ± 2 % of the rated voltage during steady state operation in float mode with the maximum supply voltage and frequency variations defined in paragraph 6.1 and a permanent load of 0 to 100 %. The maximum

transient voltage fluctuations as determined by the load changes shall be limited to $\pm 10\%$ of the rated value.

The maximum allowable voltage fluctuations ($\pm 10\%$ / $- 10\%$ of the rated value) shall apply during charging of the battery and during discharge. If the charger and the battery is not able to provide such a voltage regulation a DC/DC converter would have to be provided in series with each charger upstream of the blocking diodes to improve the efficiency of the DC source and minimise the heat dissipated. If the use of dropping diodes is acceptable for this purpose, it shall be specified in the project Data Sheet. A by-pass contactor shall be provided to by-pass the converter or the dropping diodes in case of failure and use the autonomy of the related battery when both chargers' AC supplies are lost.

Each charger shall be fed through an isolating three phase transformer.

The peak magnetising current of primary winding of the isolating transformer shall be less than 15 times the rated current..

Ripple in the battery charger output voltage shall not exceed 1% of rated rms voltage for all values of load within the charger rating with the battery not connected.

Chargers shall be able to supply the load with batteries removed.

6.4 Minimum features to be provided

Each charger shall be equipped with:

1. Protection

- AC supply three pole ON/OFF switch
- Miniature Circuit Breakers for auxiliary circuits
- Output voltage monitoring relay providing:
 - High DC voltage alarm tripping the charger
 - Low DC voltage alarm
 - Imminent battery shutdown remote alarm
 - End of discharge remote alarm for ESD trip. Contact shall be open to alarm.
 - Deep discharge protection for battery disconnection in case of lead-acid battery.
- Battery over current alarm and trip of the charger.

2. Control and monitoring

Control and monitoring shall be provided by a microprocessor based controller.

Local control and monitoring shall be given on the front of equipment and shall include as minimum:

- One alpha-numeric display with pushbuttons for operator interface
- Two LED's normal and fault
- On/off charger switch
- A buzzer providing audible alarm.
- Display and recording of elapsed time, voltage reached and Ah during the last 10 discharges.



The display shall provide the following indications as a minimum:

- Measurements:
 - AC supply voltage
 - AC supply current
 - DC output voltage
 - DC output current
 - Battery current (+ or -).
- Status of operating modes
- Alarms and faults.

Remote alarms and faults (the same as in local) shall be provided through a serial link with a protocol which shall be defined in the Project particular specification. The MANUFACTURER shall ensure the serial link compatibility with the ECS or ICSS of the plant and, if required, provide the necessary interfaces without any time and cost implication to the COMPANY.

3. A mimic (graphic display) shall be provided on the front of the cubicle, with appropriate LED's.

4. Permanent nameplates shall be provided identifying each component. Labels shall also be provided for each individual cell to facilitate test, operation and maintenance.

Nameplates shall be laminated engraved plastic with black letters on a white background.

Rating plates shall be provided as per IEC 62040 and riveted on the front panel.

7. DC Distribution panels

Each source shall be provided with a distribution panel within or adjacent to the battery charger cabinet, as indicated in the "project" particular specification.

In case of redundant DC UPS, the distribution panel shall include two incoming switches. The distribution shall be split into 2 buses "A" and "B" by means of a bus-tie switch. This would allow replacement or installation of additional outgoing CB without complete UPS distribution shutdown.

Busses suitable for "clip-on" CB mounting shall be used up to 32A.

The panel shall be located as close as practicable to the batteries but outside battery room and shall contain a two pole incoming switch.

Each outgoing circuit shall be protected by a two pole circuit breaker with overcurrent protection plus a tripping fault contact and, if specified in the Project particular Specification, also a tripping coil to facilitate isolation. The circuit breaker shall be sized for the specific circuit requirements and shall be fully selective with other devices in the circuit. The MANUFACTURER shall state in his bid the maximum rated circuit breaker that can be fitted.

All circuit breaker tripping fault contacts shall be gathered on a signalling loop and brought to control terminals for remote indication.

A minimum of 10 % equipped spare outgoing CBs shall be fitted, plus 20% additional space including the clip-on bus ready for use.



DC distribution shall be unearthed except where specified otherwise. A ground fault detector relay to provide local and remote alarm shall be installed.

This protection shall be based on the detection of a low frequency AC current circulating between DC network and earth.

This shall allow troubleshooting of the system with all circuits in operation by tracing the faulty circuit with a portable tong tester. A front panel mounted indicator shall permanently indicate the value of the network insulation impedance.

Internal wiring shall be 750 V insulated, at least flame retardant and fitted at both ends with lugs and ferrules. All external cables shall be connected on terminal blocks for connection at bottom.

8. Accessories

A complete set of tools required for maintaining the equipment shall be provided.

A tin of finish paint shall be provided to permit final "touch up" following installation.

9. Inspection and testing

The Manufacturer shall carry out tests upon completion of construction to demonstrate to COMPANY, or his representative, that the requirements of this Specification and any subsequent amendments have been fulfilled in accordance with the applicable standards and regulations.

The minimum tests required are those specified in IEC 60146, plus tests required in the Project data sheet.

9.1 Factory Acceptance Tests (FAT)

MANUFACTURER shall carry out tests upon completion of construction to demonstrate that full specification and data sheet requirements have been fulfilled. Factory acceptance tests shall be as defined in the data sheet and contractual technical documentation.

9.2 Site tests

Site tests shall be carried out as defined in the Project particular specification.

9.3 Test reports

A pro-forma of test procedures and reports shall be presented to COMPANY for approval before placing the order.

The test reports shall detail as a minimum:

- The expected theoretical values
- The tolerances
- The results of the measurements, including if applicable, any intermediate values which have caused a temporary rejection.

The test reports shall be included in the contractual technical documents, and shall be considered as an integral part of them.

10. Documentation

As a minimum, the following documents shall be provided for Company's review at the tender stage :

- Overall arrangement drawing
- One line diagram
- Schematic diagram
- Battery sizing calculation note
- Type test reports (in particular battery and battery charger gas recombination type test by a recognised certifying authority).
- Gas release calculation depending on battery charging mode
- Battery cabinet ventilation calculation note (when applicable)

Unless otherwise specified in project particular specification, SUPPLIER shall at least provide the following documents :

- Overall arrangement drawing
- Civil works drawings
- One line diagram
- Wiring diagram
- Schematic diagram
- Maintenance and operation instructions
- Spare part list
- Detailed equipment information (technical documentation).
- Type test reports
- FAT reports

11. Transport/packing

In all cases, vented batteries shall be delivered electrically formed by the Manufacturer. They shall be shipped preferably filled and charged, but this choice is left to the Manufacturer and/or ENGINEER / CONTRACTOR based on site delivery conditions.

Sealed batteries shall be delivered charged.