

GENERAL SPECIFICATION

ELECTRICAL

GS EP ELE 261

Solar Power System

02	10/2012	Minor update
01	01/2011	Up dated as marked
00	10/2005	First issue
Rev.	Date	Purpose of the revision

Owning entity: DEV/TEC	Managing entity: DEV/TEC/ELE
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1. Scope

This specification covers the minimum requirements for design, manufacture, operation and testing of solar power system in order to supply electrical loads for offshore or onshore unattended/unmanned electrical installations.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

PV generators, stationary batteries, controllers/battery charging regulators, main junction boxes and 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.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
IEC 60068 (All parts)	Environmental testing - All parts
IEC 60079 (All parts)	Explosive atmospheres - All parts
IEC 60146 (All parts)	Semiconductor converters - All parts
IEC 60255 (All parts)	Measuring relays and protection equipment - All parts
IEC 60269-1	Low-voltage fuses - Part 1: General requirements
IEC 60331-21	Tests for electric cables under fire conditions. Circuit integrity - Part 21: Procedures and requirements-Cables of rated voltage up to 0.6/1.0 kV
IEC 60332-3-22	Tests on electric and optical fibre cables under fire conditions - Part 3-22: Tests for vertical flame spread of vertically-mounted bunched wires or cables-Category A

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Reference	Title
IEC 60364-7-712	Electrical installation buildings - Part 7-712: Requirements for special installations or locations - Solar photovoltaic (PV) power supply systems
IEC 60529	Degrees of protection of enclosures
IEC 60896 (Parts 11; 21)	Stationary lead-acid batteries - Parts 11; 21
IEC 60904 (All parts)	Photovoltaic devices - All parts
IEC 61000 (All parts)	Electromagnetic compatibility - All parts
IEC 61204	Low-voltage power supply devices, d.c. output - Performance characteristics
IEC 61215	Cristalline silicon terrestrial photovoltaic (PV) modules - Design qualification and type approval
IEC 61427	Secondary cells and batteries for photovoltaic energy system (PVES) - General requirements and methods of test
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 62040 (All parts)	Uninterruptible power systems (UPS) - All parts
IEC 62259	Secondary cells and batteries containing alkaline or other non-acid electrolytes - Nickel-Cadmium prismatic secondary single cells with partial gas recombination
IEC 62262	Degrees of protection provided by enclosures for electrical equipment against external mechanical impact (IK code)
IEC 62402	Obsolescence management - Application guide
NASA Data Base	NASA Surface Meteorology and Solar Energy - Available Table (http://eosweb.larc.nasa.gov/sse)

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Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
GS EP COR 350	External protection of offshore and coastal structures and equipment by painting
GS EP COR 354	External protection of onshore structures and equipment by painting
GS EP ELE 079	Electrical apparatus for potentially explosive gas atmospheres
GS EP ELE 137	Distribution boards
GS EP STR 103	Design and fabrication of skids and equipment supporting structures
GS EP TEC 007	Obsolescence and Lifetime Cycle Management

3. General

3.1 Environmental data

The Solar Power System shall be designed in accordance with the environmental conditions as defined in the Project Particular Specification:

- Hazardous area classification (if any)
- Air temperatures (highest, lowest and average)
- Humidity ratios (highest, lowest and average)
- Altitude
- Maximum wind speeds in function with its dominant direction (1 hour, 1 minute, 3 seconds gust)
- Solar radiation characteristic at site.

In case H₂S might be present, special provisions shall be taken by the Manufacturer to avoid equipment/material corrosion. The Manufacturer shall indicate the proposed protection measures in his bid.

3.2 System reliability and availability

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.

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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 Solar power system description

Solar Power system shall be designed in accordance with the Typical Single Line Diagram presented in Appendix 2 or Appendix 3.

Solar power system includes:

- Solar photovoltaic generators
- Controllers/battery charging regulators
- Stationary batteries
- Main junction box (connects controllers/battery charging regulators to stationary battery banks and the main DC distribution panel)
- Distribution panels/boxes.

Distribution shall be designed in accordance with the type of loads (motors, instrument, telecom) to be fed. Particular care shall be taken to avoid disturbances due, for instance, to motor starting (DC/DC or DC/AC converters). The Solar power system shall meet EMC requirements of [IEC 61000](#) (all parts).

3.5 Modes of operation

Solar photovoltaic generators shall simultaneously ensure battery charging and consumers' supply.

Controllers/battery chargers shall maintain output voltage within tolerances as specified in the Project Particular specification.

Stationary batteries shall ensure:

- Continuous power supply without solar photovoltaic generator
- Peak electrical consumptions.

Solar power system arrangement is designed with one or several DC sources and one distribution station.

In accordance with the Typical Single Line Diagram (Appendix 2 or Appendix 3), each DC source comprises:

- One solar photovoltaic generator
- One DC controller /battery charger
- One 2-pole circuit breaker

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- One stationary battery branch
- One battery branch isolator inside the main junction box to connect the DC source to stationary battery branch and the main DC distribution panel.

Battery cells shall be one of the following types:

- Nickel cadmium batteries with partial gas recombination (in accordance with [IEC 62259](#))
- Vented lead acid batteries with tubular positive plates (in accordance with [IEC 60896-11](#))
- Valve regulated gas recombination lead acid cells with recombination ratio $\geq 95\%$ (in accordance with [IEC 60896-21](#)) and tubular positive plates.

High ambient temperatures (above 30°C) severely reduce operating life of lead acid batteries (for every 10°C increase over 30°C, the reduction of operating life will be 50%) and increase the risk of sudden failures. Low ambient temperatures (below 0°C) reduce available capacity of lead acid batteries.

For unattended/unmanned or critical applications (offshore platform for instance) with extreme temperatures (above 30°C or below 0°C), partial gas recombination nickel cadmium battery cells shall be used.

DC sources shall be one of the following types:

3.5.1 Type 1

Solar power system is designed with only one DC source and one distribution station (DC or DC/AC) to supply consumers (see Appendix 2) that do not entail safety of persons or equipment in case of loss of supply (e.g. starting batteries), etc.

3.5.2 Type 2

Solar power system comprises one distribution station fed by two identical DC sources in parallel operation sized to 50% each (see Appendix 3). This arrangement shall supply loads that could entail safety of persons or equipment in case of loss of supply.

4. Design requirements

4.1 Construction requirements

4.1.1 Solar Photovoltaic generator

4.1.1.1 Definition

The abbreviation "PV" is used for "solar photovoltaic".

For better understanding, PV generator arrangement is introduced in Appendix 1; and, the following terminology shall be used, as per [IEC 60364-7-712](#):

- PV cell is the basic PV device which can generate electricity when exposed to light such as solar radiation.
- PV module is the smallest completely environmentally protected assembly of interconnected PV cells.

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- PV array is mechanically and electrically integrated assembly of PV modules, and other necessary components, to form DC power supply unit:
 - PV modules shall be connected in series to achieve the required voltage and built a PV string
 - Several PV strings shall be jointed in parallel and electrically protected by components inside an Array Combiner Box.
- PV generator is an assembly of PV arrays.

4.1.1.2 General

PV arrays and boxes (junction, Array Combiner and PV generator boxes) shall be outdoor, skid mounted, at least IP66-IP68 (IEC 60529 - IEC 62262) and shall be suitable for the site installation conditions (refer to GS EP ELE 079, GS EP COR 350 and GS EP COR 354).

Boxes shall be arranged for front operation and maintenance with a key lockable access door. Warning labels shall be fitted in prominent positions advising care to be taken for access to live equipment.

PV arrays and boxes shall be isolated at 750V DC as minimum.

PV internal wiring shall be as a minimum in accordance with the cubicle internal wiring requirements (see part 4.1.2.6).

Bolts, nuts, washers, clamps... shall be of the same type as than PV array supports. If two types of materials are fitted together, insulating washers shall be required.

Boxes and skids shall be designed to be lifted by use of removable eye bolts.

Two earthing plates or terminals shall be provided at diametrically opposite ends of supports, structures and boxes to allow earthing and bounding external connections to general earthing grid.

Bird spikes shall be provided on the PV arrays in particular to prevent birds from landing, roosting, nesting and/or dropping.

4.1.1.3 PV cells

PV cells shall be high quality and multi crystalline construction.

4.1.1.4 PV modules

PV module shall encapsulate PV cells with tempered glass and anti-reflective coating as cell finish on the front side as minimum.

PV module should be capable to withstand air velocity as specified in the Project Particular specification.

PV cell interconnections shall be redundant, reliable connection, only sealed connection box on cell array structure.

Each PV module shall be provided with by-pass diode inside a junction box.

Each Individual module shall be electrically and mechanically interchangeable.

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High efficiency cell module (W/m²) shall be required to optimise the allocated spaces of PV array arrangement.

4.1.1.5 PV arrays

PV Array shall be:

- A series-parallel combination of PV modules by the Array Combiner Box Components in order to provide the required voltage and current
- Pre-assembled and skid mounted on supports.

4.1.1.5.1 Array Combiner Box

Array Combiner Box shall be designed in order to:

- Combine the grouped PV modules into a common output
- Protect circuit against lightning effects (over-voltage) surges with surge arresters and surge diverters
- Isolate each PV string and prevent with blocking diode inside
- Test array in current and voltage
- Carry a means for connection and disconnection of individual PV array for maintenance, testing, repair and replacement.

4.1.1.5.2 PV array support

PV array support shall be:

- Epoxy painted stainless steel 316L for corrosive atmosphere
- Epoxy painted hot dip galvanized carbon steel for non corrosive atmosphere.

Coating shall comply with Company General Specification [GS EP COR 350](#) or [GS EP COR 354](#) requirements.

4.1.1.6 PV generator

PV generator shall be:

- A series-parallel combination of PV arrays by the PV Generator Box Components to achieve the desired operating voltage and current
- Skid mounted on support structure.

4.1.1.6.1 PV generator box

PV generator box shall be designed in order to:

- Combine the grouped PV arrays into a common output
- Test array in current and voltage.

A complete PV generator drawing set shall be inside.