



**Resalat Oil Field Development Project  
Phase 1 (EPC-EPD)**



Contract  
No.

Specification for 110VDC UPS System

Class

1

5365

Pr. Code  
LRSL

Area  
000

Disc.  
EL

Type  
SP

Seq.  
618

Rev.  
03

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## Specification for 110VDC UPS System

					<i>S.S.</i>	<i>A.S.</i>	<i>M.A.</i>	
03	08-May-21	Approved for Construction	IOEC		S.Saffari	A.Samadi	M.Aghaei	-
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**REVISION RECORD SHEET**

REV. NO.	PURPOSE	LIST OF UPDATED MODIFIED SECTIONS IF ANY
01	Reissue based on client comment	Remove some discrepancy with electrical design criteria
02	Reissue as AFC revision	-
03	Reissue as AFC revision	-



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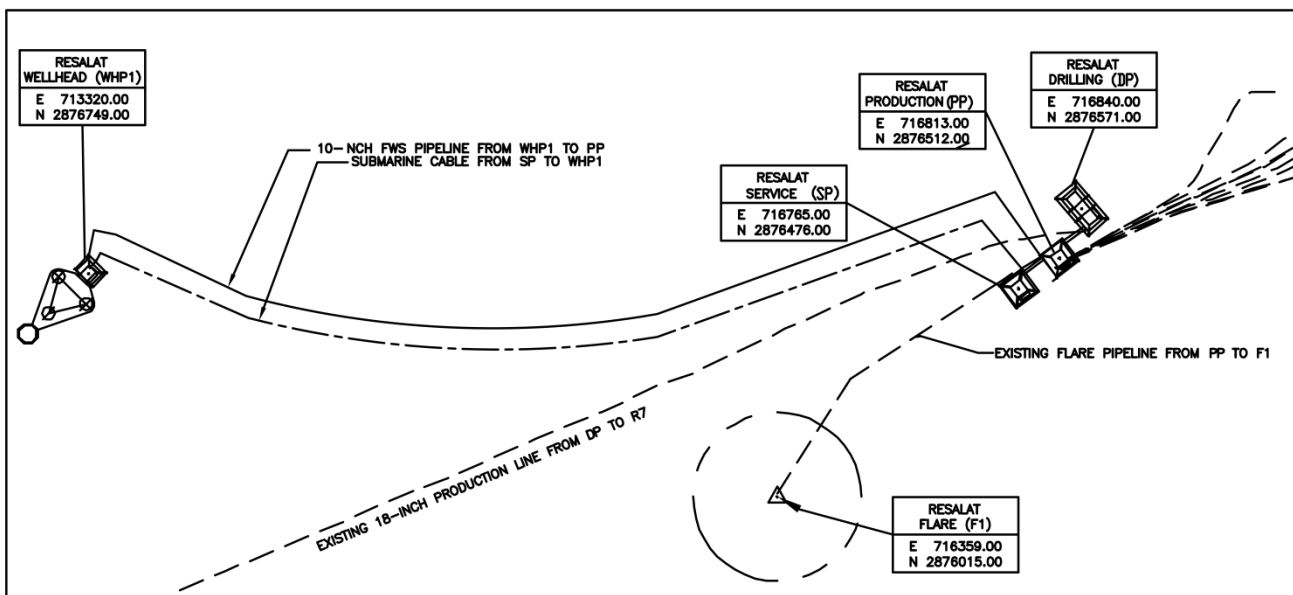
**1. INTRODUCTION**

**1.1. Development Overview**

The Resalat Field previously known as Rakhsh Field, is located in the Persian Gulf, some 80 km to the South of Lavan Island, in water depth of 65-75 meters. The facilities which were originally developed in 1968 have sustained some damage due to the Iran/Iraq war and adverse climate conditions thereafter.

To increase oil production capacity from this field (adding 12,000 stock barrels per day to current production), Iranian Offshore Oil Company (IOOC) has defined new project which includes Engineering, Drilling, Procurement, Construction for following items:

- New satellite Wellhead Platform (WHP1) with totally nine (9) conductor slots.
- Development and renovation of Existing offshore complex consist of new power generation, control system, HVAC, Electrical /control room, electrical panels(LV &MV),process & utility piping, and all necessary activities which shall be done for connection to existing facilities(Tie in requirements)
- Drilling of two new production wells in R1 and two wells in WHP1 platform and Re-entry and work-over of two existing well in R1 platform.
- One 10” productions submarine pipeline from WHP1 to PP and a single submarine cable (power and data) from SP to WHP1
- Inspection, Strengthening, Modification and Repair of existing R1 complex Jackets and topsides and replacement of boatlanding and Barge Bumpers.



**Figure 1: Resalat Development Field Layout (Datum ED 77, Zone 39, Cent. Meridian 51° East)**



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**1.2. Purpose of Scope**

This specification covers the minimum requirements for design, manufacture, quality control, testing and finishing of 110 V DC UPS System.

**1.3. Definitions**

<b>PROJECT</b>	Resalat Oil Field Development – Phase 1
<b>COMPANY</b>	Iranian Offshore Oil Company (IOOC)
<b>CONTRACTOR</b>	Consortium of Iranian Offshore Engineering and Construction Company (IOEC) and Intelligent Solutions Inc. (ISI)
<b>SUB-CONTRACTOR</b>	Tehran Raymand Consulting Engineers (TRCE)
<b>PURCHASER</b>	Any firm who buy services, material and/or equipment for execution of the project within a dedicated contract.
<b>SUPPLIER</b>	Any vendor, manufacturer who supply any Service, Material or Equipment for the project
<b>SHALL</b>	Refer to a mandatory requirement
<b>SHOULD</b>	Refer to a recommendation
<b>MAY</b>	Refer to one acceptable course of action

**2. CODES AND STANDARDS**

LRS L-000-PM-LI-743	List of Applicable Codes and Standards
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**3. GENERAL STATEMENT**

The attached SPECIFICATION FOR DC UPS SYSTEM is confirmed as the Specification for 110 VDC UPS system, except as added/modified/deleted herein, and renumbered/reissued as Specification for 110 VDC UPS System (LRS L-000-EL-SP-618) for Resalat Oil Field Development Project, Phase 1.



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**4. ADDITION/MODIFICATION/DELETION**

The following items refer to the attached SPECIFICATION FOR 110VDC UPS SYSTEM.

The clauses set out below modify or replace the clauses in the original specification as noted.

4.1 Section 10. Design and construction- General (5.1.7)

<b>Mod.</b>	The batteries of the 110 V DC duplicate static UPS units shall be capable of supplying the whole assembly control circuit load including the supply to electronic relays for a period of minimum <del>8</del> <b>4</b> hours and then be able to trip all connected switching devices in succession. Trip circuits shall normally be de-energised with energising to trip.
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4.2 Section: 10.2 Safety Requirements (5.2.3)

<b>Mod.</b>	The minimum enclosure degree of protection according to IEC 60529 shall be: <del>External: IP 55.</del> Indoor installation: IP42 <del>Internal: IP 42 (live parts shielded).</del> Open door: IP 20 (Live part shielded)
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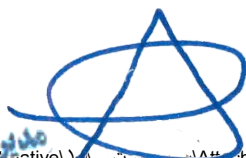
Iranian Offshore Oil Co

**SPECIFICATION FOR DC UPS SYSTEM**

Area	Discipline	Document	Scope/Location	Sequence	Rev


**SPECIFICATION FOR  
DC UPS SYSTEM**

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		CONTRACTOR			IOOC	



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- Contract scope of work
- Design philosophy
- Specifications
- Applicable codes and standards

## 5. ABBREVIATIONS

Standard terms and abbreviations are used in this document. Listed below are the abbreviations that may be used here and in subsequent documents.

MV	Medium Voltage
LV	Low Voltage
ICSS	Integrated Control and Safety System
RMU	Ring Main Unit
UPS	Uninterruptible Power Supply
MCC	Motor Control Centre
LCS	Local Control Station
VDU	Video Display Unit
LNAN	Liquid Natural Air Natural
ACB	Air Circuit Breaker
VCB	Vacuum Circuit Breaker
NER	Neutral Earthing Resistor
SCADA	Supervisory, Control and Data Acquisition
FBA	Factory-built Assemblies
IACS	International Annealed Copper Standard
VT	Voltage Transformer
CT	Current Transformer
LTR	Local Technical Room
MCB	Miniature Circuit Breaker
RCCB	Residual Current Circuit Breaker
MCCB	Molded Case Circuit Breaker COG
COG	Centre of Gravity
SWL	Safe Working Load
PCS	Process Control System

## 6. INTERNATIONAL STANDARDS

- IEC 60051-2 Recommendations for direct acting indicating analogue electrical measuring instruments and their accessories.
- IEC 60073 Coding of Indicating Devices and Actuators by Colors and Supplementary Means..
- IEC 60146 Semiconductor Converters.
- IEC 60269 Low Voltage fuses.
- IEC 60391 Marking of Insulated Conductors.




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## 10.2 Safety Requirements

5.2.1 The system components shall be modularised and shall be housed in cabinet(s) in such a way that its main components are physically segregated, and arranged as to minimise the risk of short circuits and shall ensure personnel and operational safety at all times.

5.2.2 Components shall be capable of withstanding the thermal and dynamic stresses resulting from internal and external short circuits and circuit switching operations, etc. Damage arising from component failure should be confined to the component concerned.

5.2.3 Materials which are highly persistent or toxic to the environment or considered international potential carcinogens shall not be used.

5.2.3 The minimum enclosure degree of protection according to IEC 60529 shall be:

- External : IP 31.
- Internal : IP 20 (live parts shielded).

5.2.4 All live terminals of door-mounted equipment having a maximum (peak) voltage of greater than 24 Volts shall be shrouded or otherwise protected by barriers to a degree of protection of at least IP 20. Barriers shall be of rigid transparent insulating material to enable the screened components to be identified. Protection relays which can cause tripping of the unit shall not be mounted on the door.

5.2.5 All bare busbars and all live terminals of equipment and components located within the enclosure shall be similarly protected by barriers or shrouds to a degree of protection of at least IP 20, unless adequately recessed within the enclosure to prevent inadvertent contact or short circuit by personnel when performing control circuit adjustments or when resetting/replacing protective devices, etc.

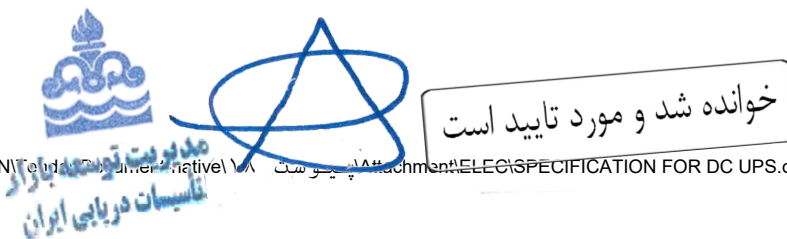
## 10.3 Unit Configuration And Tie-In


5.3.1 DC UPS system shall be consists of two DC UPS units. The required number of UPS units will be indicated in the requisitioning documents. The DC UPS units shall be autonomous, without the need of supplies other than the main power supply. A DC UPS unit shall comprise an input transformer, a rectifier / battery charger with its pertaining battery.

The rating of DC UPS units in redundant systems shall be based on "n+1" principle where "n" is the number of units required to fulfill the load requirements. The DC UPS system shall also include a DC distribution panel.

A diagram may be attached to the requisitioning documents to show the preferred configuration and connection details. This diagram shall be read in conjunction with the single-line diagram and data sheets.

5.3.2 The system shall be complete with all necessary protection, control and alarm devices. Special requirements will, when applicable, be specified in the requisition.



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5.3.3 Where practical, identical components, subassemblies and modules shall be used to allow interchangeability, minimise spare parts and to simplify servicing and repairs.

5.3.4 Seller shall specify the current rating of general purpose fuselinks (type gG, in accordance with IEC 60269) or of a moulded-case circuit breaker (category A, in accordance with IEC 60947-2) which Buyer shall provide in the mains supply switchboard energising the DC UPS unit.

5.3.5 Seller shall provide suitably sized fuses or a moulded-case circuit breaker on the battery circuit, to isolate the battery in the event of short circuits on the output of the DC UPS unit. The protection device shall be of the wall mounted type, installed adjacent to the battery.

10.4 **Unit Rating**

5.4.1 The rated output of the DC UPS unit rectifier shall be based on standard duty class I of IEC 60146-1-1, clause 3.10.3.5.

5.4.2 The output of the rectifier shall, during normal operation, continuously supply the power requirements of the load while simultaneously maintaining the battery charge in the float charge mode. In the event of an interruption or depression in the AC mains voltage to the rectifier, the battery shall supply the load requirements for not less than the specified time whilst maintaining the output voltage within the permissible limits. The battery capacity selected by Seller in order to achieve this will henceforth be referred to as its 100% nominal capacity.

5.4.3 Upon restoration of the AC mains voltage, the rectifier shall automatically resume supply of the load requirements while simultaneously recharging the battery. The rate of recharging shall, depending on type of battery, be such as to restore it within the specified time to a capacity which is either its 100% nominal capacity or a percentage thereof. Where rapid charging is necessary to fulfil this requirement, then this shall only be possible by manual initiation.

5.4.4 The DC UPS unit shall be suitable for operation in parallel with one or more identical units, that may have unsynchronised AC supplies.

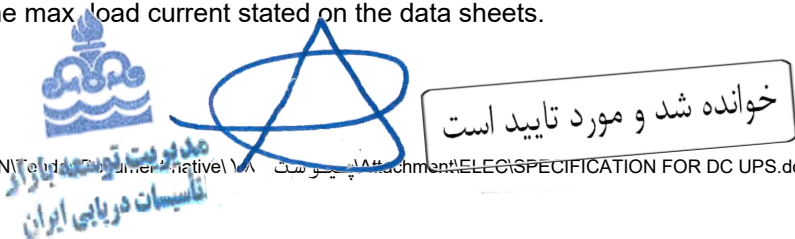
10.5 **Rectifier**

10.5.1 General


5.5.1.1 The rectifier shall operate according to the constant voltage, current limiting principle and shall incorporate a soft-start feature to gradually accept load on initial energising. The rectifier shall restart automatically upon restoration of the mains power supply following a mains supply interruption.

5.5.1.2 If not indicated otherwise, the rectifier shall be equipped with inrush current limiters, restricting the current at line side to maximum 400 % Inom.

5.5.1.3 Battery chargers shall be fully automatic for operation with its specified battery and shall be of the highest efficiency type. Charger rating to be specified by Seller. For redundant battery rectifier systems the charger shall be capable of recharging the fully discharged battery up to 100% within eight hour with the load disconnected, or be capable to charge the fully discharged batteries to 80% within 15 hours when both rectifiers are operating and each is supplying 50% of the max. load current stated on the data sheets.

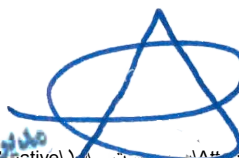





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From the above two conditions, the largest rectifier capacity shall be applicable.

- 5.5.1.4 The ripple in the battery charger output voltage shall not exceed two percent of the nominal voltage for all values of load within the charger rating with the battery disconnected.
- Ripple current limiting shall be provided to prevent short circuiting in the battery cells.
- 5.5.1.5 The charger shall be capable of limiting the output current at approx. 105% of the charger rating. In order to allow operation of the rectifier with disconnected battery, additional LC filters shall be provided to trip any MCB as specified, upon faults in the outgoing circuits.
- 10.5.1.6 Each rectifier shall have a main incoming load break switch with padlock facilities in the "off" position. Unless otherwise specified on the requisition, DC UPS units having rated outputs up to and including 1.8 kW shall have single-phase and neutral inputs and units having rated outputs in excess of 1.8 kW shall have 3-phase and neutral inputs.
- 5.5.1.7 Main circuit switches (mechanical) shall comply with IEC 60947-3 and be of the independent manually operated air-break type for continuous duty. They shall comply with utilisation category AC23 and DC23 for AC and DC switches respectively.
- 5.5.1.8 Contactors shall comply with IEC 60947-4-1 and be rated for uninterrupted duty and intermittent duty of at least class 0.1. The utilisation category for DC contactors shall be not less than DC-5 and for AC contactors not less than AC-3.
- 5.5.1.9 Transformers and reactors shall be of the air-cooled type and comply with IEC 60146-1-3.
- 5.5.1.10 Printed circuit boards (PCBs) shall be installed in standardised electronic equipment frames and be fitted with handgrips for easy removal. The frames shall incorporate card guides to facilitate the correct insertion of PCBs, and allow access to the wiring side of connectors. PCBs shall include visual light emitting diode (LED) status indications and test connections on the front to facilitate fault diagnosis.
- 5.5.1.11 IGBT technology and 12 pulses shall be considered.
- 10.5.2 Battery float-charge operation
- 5.5.2.1 The rectifier steady state DC output voltage variations shall be controlled to within plus 1% and minus 1% of the set value (corresponding to the battery float-charge voltage) during load variations between zero and the rated output of the rectifier, and during steady-state input voltage and frequency variations.
- 5.5.2.2 On-line adjustment of the set value of float-charge voltage shall be possible by means of either a potentiometer on the relevant control circuit card or, where applicable, by an appropriate menu-driven software change.
- 5.5.2.3 The DC output current of the rectifier, when operating under current-limiting conditions, shall be controlled to within plus 2% and minus 2% of the set value.



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10.5.3 Battery rapid-charge operation

5.5.3.1 Operation of the selector switch to the rapid-charge position shall initiate an automatically controlled rapid-charge cycle according to constant current/constant voltage characteristics.

5.5.3.2 The duration of the battery rapid-charge operation shall be controlled by an adjustable timing relay. The relay shall be manually activated and not automatically on detection of the battery voltage and current conditions. After the elapsed time, the timing relay will re-instate the rectifier output voltage to that corresponding to continuous float charge operation. The timer shall be set by Seller.

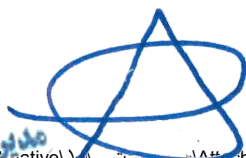
5.5.3.4 For redundant DC UPS units, the units shall be provided with a manually operated mechanical interlock between the rectifier float/rapid-charge selector switch and the main outgoing circuit switch of the DC UPS unit, to ensure that the external DC load is disconnected from the unit throughout rapid-charging operations, such that the selector switch is only operable if the main outgoing circuit switch is "off".

Additional interlocking shall be provided to prevent that all chargers of the DC UPS system are placed in rapid charge operation simultaneously.


5.5.3.5 When operating under constant current limiting conditions, the DC output current of the rectifier shall be controlled to within plus 2% and minus 2% of the set value.

5.5.3.6 When operating under constant output voltage conditions, the voltage shall be controlled to within plus 1% and minus 1% of the set value.

5.5.3.7 On-line adjustment of the set value of the final voltage applied to the battery shall be possible by means of either a potentiometer on the relevant control circuit card or, where applicable, by an appropriate menu-driven software change.


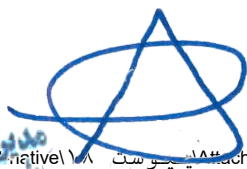


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**10.6 Battery and DC circuit**

- 5.6.1 Battery cells shall be of the pocket-plate, sintered-plate or fibre-plate very low maintenance nickel-cadmium types in accordance with IEC standard.
- 5.6.2 The battery size shall be based on supplying the connected load profile during the autonomy time at minimum ambient temperature (for the battery room) over the expected lifetime, while maintaining the output voltage within the defined tolerances.
- 5.6.3 The battery manufacturer shall specify the rms value of the actual, and the maximum permissible, ripple current through the battery, as a percentage of the battery nominal ampere-hour capacity, when the DC UPS unit is operating under battery float-charge conditions.
- 5.6.4 Terminal pillar seals shall be of a design that prevents the initiation of pillar corrosion.
- 5.6.5 Cell containers shall be plastic, non-flame propagating and mechanically shock resistant and shall permit the electrolyte level to be viewed through the container material. Cells shall be fitted with flame-arresting vent plugs.
- 5.6.6 Batteries shall be supplied complete with inter-cell connectors. Inter-cell connectors and terminals shall be insulated or otherwise provided with protective covering to prevent inadvertent short circuiting. Inter-cell connectors shall be sized for carrying the battery through fault current.
- 5.6.7 All batteries shall be located in a dedicated battery room. Unless indicated otherwise in the requisitioning documents, an unenclosed, free-standing battery support rack shall be furnished with each set of batteries. Provisions for mounting the battery support rack against the wall and provisions for fixing the battery cells to the shelves shall be furnished.
- 5.6.8 Battery support racks shall be of steel and shall have a plastic or epoxy coating to provide suitable protection against the effects of electrolyte spillage. Battery racks shall have plastic insulating rails at all points of contact with the cell containers.
- 5.6.9 For inspection and maintenance purposes the support racks shall be such that the top of the upper battery row shall not exceed 1600 mm and total rack depth shall not exceed 1000 mm.
- 5.6.10 Very low maintenance nickel-cadmium cells shall be supplied dry and discharged.
- 10.6.11 Liquid electrolyte shall be supplied with the battery in suitable sealed containers.
- 10.6.12 The DC circuit shall be unearthed unless otherwise specified in the requisition.

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5.6.13 Automatic Battery monitoring for nickel cadmium battery shall be provided with a battery string monitoring system (e.g. battery symmetry control). This device will switch off the UPS incoming supply for one minute and the battery will feed the load. The voltage drop will be monitored and a battery fault alarm initiated in case of voltage drop greater than the preset alarm value. This facility shall be programmable to facilitate automatic testing periods and the level of discharge. The monitoring system shall compare the discharge values with the actual pre-programmed battery discharge characteristics and shall be capable of providing a detailed analysis of the battery condition. Additionally, provision shall be made to manually select a full battery discharge test.

### 10.7 Output Voltage Requirements

5.7.1 The output voltage shall be limited to within plus 10% and minus 10% of the nominal value. This limitation applies during battery recharge operations, float-charge operations and during battery discharge operations corresponding to the maximum load current and for the specified discharge period.

**Note:**

Switched diodes in redundant or n+1 UPS unit configurations or supplementary battery cells as a means of limiting DC voltage variations are not acceptable.

5.7.2 The output voltage dynamic response of the DC UPS unit, with battery disconnected, shall not vary more than plus 20% and minus 10% of nominal output voltage in the event of instantaneous load changes of up to 50% rated output. The output voltage shall be restored to within the steady-state limits within 100 milliseconds.

### 10.8 Mains Voltage Distortion

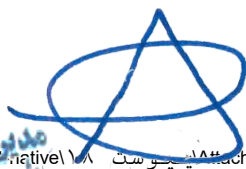
Based on short circuit capacity of the supply system of 40 times the kVA rating of the DC UPS unit, the current harmonic consumption shall be such that the total voltage distortion caused by the unit on the mains shall be less than 5%. The relative harmonic content and crest factor of the input current shall not exceed 50% and 2.5 respectively.

### 10.9 Unit Enclosure

5.9.1 The cabinet(s) shall have sufficient mechanical strength to be self-supporting for either wall or floor mounting. The cabinet(s) shall have adequate lifting facilities. The cabinet shall be suitable for operation and maintenance with its rear panel against a wall and with similar units located immediately on both sides. The overall height of floor mounted panels shall not exceed 2300 mm.


5.9.2 All components shall be accessible from the front. When the rectifier system is housed in more than one (1) cabinet, these shall be suitable for side-to-side mounting.

5.9.3 Unless indicated otherwise in the requisitioning documents, the internal cooling of the DC UPS unit shall be by natural ventilation conforming to IEC 60146-1-1. If forced air cooling is necessary, then the DC UPS unit shall be capable of continuously delivering its rated output with any one forced air ventilation fan out of service. Under the latter condition, the maximum continuous temperature of components shall not be exceeded. Seller shall provide all necessary



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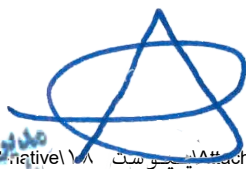
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**10.12 Distribution Panels**

- 5.12.1 When specified in the requisition, a DC distribution panel shall be supplied.
- 5.12.2 The distribution panel board shall consist of a fully insulated DC bus system with miniature circuit breakers (MCB) as specified on attached specification/data sheet and drawings.
- 5.12.3 Outgoing circuits of the DC distribution panel shall have overcurrent and short circuit protection with auxiliary contacts to indicate operation of any device. The contacts shall be connected in series and wired to the display and diagnostic system.
- 5.12.4 If not indicated otherwise on drawings and data sheet, the DC system shall be unearthed (isolated), and earth detection shall be provided on the load bus with alarm indication. Earth detector sensitivity shall be sufficient to operate for a ground fault having a fault resistance of 1000 Ω or less. (Max. current +/- 24 mA for 24 VDC).
- 5.12.5 ELM's (Earth Leakage Monitors) shall be provided on the each outgoing feeders. In case the number of outgoing circuits exceeds 5 an earth fault test facility shall be installed, able to test each feeder individually without interrupting the circuit.
- 5.12.6 DC distribution panels receiving their supply from redundant units shall be provided with blocking diodes for each incoming supply. These blocking diodes shall be physically located and mounted so that they can be safely removed and replaced with the panel energised. They shall be so rated that the temperature rise of the diodes when carrying the system load shall not result in diode surface temperatures which could inflict burns on personnel or cause damage to adjacent equipment or insulation.
- 5.12.7 The distribution panel, as specified in the datasheets, shall be provided with anti-condensations heaters suitably rated to prevent the formation of harmful condensation inside the enclosure. The heater shall be supplied complete with thermostat and combined MCB / RCD device with a residual current setting of 30mA


**10.13 Internal Wiring And Terminations**

- 5.13.1 Insulated stranded copper conductors shall be used for secondary wiring. The size and type shall be selected on current carrying capacity, voltage and mechanical strength. Wiring between terminals shall be continuous and without joints.
- 5.13.2 Wires shall be held in position by means of insulated tubes, channels, cleats or plastic strips and shall be routed so as to avoid mechanical damage. Channels, tubes, etc. shall not be filled to more than 75% capacity during manufacture. Wiring between fixed portions and hinged doors shall in addition to the electrical insulation have protection against abrasion or entrapment and shall not be carried over or bent around sharp edges.
- 5.13.3 Terminals shall be of the non-loosening type and only accept one wire, unless the terminals are specially designed to accept more than one wire. Terminals shall be constructed in such a way that direct contact between screws, bolts or nuts and the conductor is prevented. Partitions shall be placed between terminals of different voltages. Stranded wiring ends shall be provided with compression type pre-insulated wire pins with insulation support.



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5.13.4 Terminals to accommodate wiring supplied by buyer shall be sized to accept minimum 2.5 sq. mm wires for control and minimum 4 sq. mm wires for power and current transformer secondary wiring. A minimum of 25% spare control terminals shall be provided in each panel.

10.14 **External Cabling And Terminations**

5.14.1 All panels and enclosures shall have facilities for the entry of cables from the top or bottom as specified in the requisition. Control cables shall be accessible from the front of the enclosure.

5.14.2 All connection material, cable supporting system and clamping shall be supplied and suitable for the size and the number of conductors. Ample space for terminating the external cables shall be provided. All outgoing cable compartments shall be provided with fully gasketed removable gland plates for termination using cable glands. A minimum of 25% spare entries shall be provided. Compression type cable glands suitable for the cables specified on the requisition shall be included in the scope of supply.

5.14.3 A separate compartment shall be supplied for the terminal strips for all incoming and outgoing cables. Separate sections shall be provided for digital, analogue and power cables. Interconnecting cables to remotely located equipment shall be installed by the Buyer.

10.15 **Earthing**

5.15.1 Where a number of electrical components are to be earthed, parallel earthing shall be employed and not series looping of equipment.

5.15.2 An earth rail with a suitable number of earthing bolts or screws shall be provided in a position close to the external cable glands to facilitate termination of cable earth braids or armouring. Individual connections for all earth wires shall be provided.

5.15.3 A threaded brass earth stud of not less than 6 mm diameter, with nuts and spring washers, shall be provided within the enclosure for termination of a separate single-core earth cable.

5.15.4 Electrical conductivity between the exposed non-current-carrying conductive parts of the control panel components and the enclosure and between the enclosure and the earth rail and the earth stud shall be such as to maintain effective continuity of earth circuits.

5.15.5 The minimum size of earth conductors shall be 2.5 sq. mm for internal earth connections. Earth connections shall be yellow/green coloured insulated copper flexible wires.


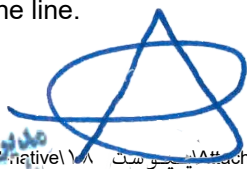
5.15.6 Removable metal parts, including doors, shall be earthed.

10.16 **Electromagnetic Compatibility**

5.16.1 The rectifier system shall meet the requirements of IEC 61000.

5.16.2 The control system shall be immune from spikes and voltage distortions, etc., due to operational and/or fault conditions within the system and for super imposed high-frequency commands from the line.


10.17 **Noise L**

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**13. CORROSION PROTECTION**

- 8.1 All metal parts shall be protected against corrosion.
- 8.2 Colour of the top coat of panels shall be seller's standard.
- 8.3 To avoid corrosion by the electrolyte, special provisions shall be taken for the battery rack and/or cabinet.

**14. MARKING**

**14.1 Marking Of Wiring And Cables**

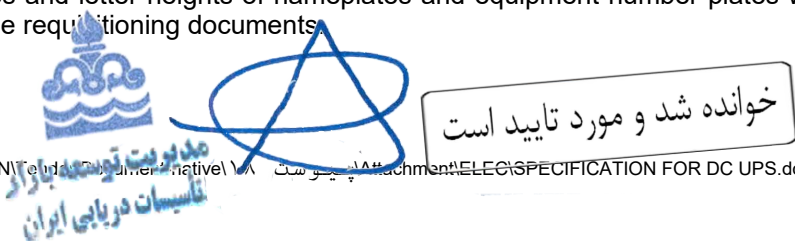
- 9.1 Individual wires or cables terminating at fixed (not plug-in) components shall be identified by means of ferrules of insulating material marked in accordance with the manufacturer's drawings. Wrap around, adhesive type markers shall not be used.
- 9.2 Wiring shall be marked in accordance with IEC 60391 applying the local end marking method as defined in clause 3.4.1.a.2.
- 9.3 Interconnecting cables and terminals shall be marked as shown in the respective block or connection diagrams supplied by seller.


**14.2 Identification Of Equipment Terminals**

Equipment terminals shall be identified in accordance with IEC 60445.

**14.3 Rating And Name Plates**

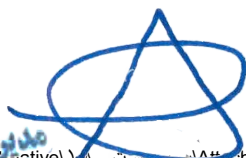
- 9.2.1 Rating plates shall as a minimum comprise all information required according to IEC 60146-1-1, subsection 3.11, including the purchase order number and the year of manufacture.
- 9.2.2 The rating plates shall be made of corrosion-resistant metal or "Resopal" (white-black-white), and shall be fixed to a non-removable part of the equipment on a well visible place.
- 9.2.3 If additional rating plates have to be mounted on removable parts. Seller's serial number and reference shall be repeated on these rating plates.
- 9.2.4 Nameplates shall be fixed in such a way that they are easy to replace.
- 9.2.5 When the system is delivered with several separate cabinets or racks, each individual panel or rack has to be clearly tagged.
- 9.2.6 Additional plates shall be provided indicating the equipment number and/or description.
- 9.2.7 Sizes and letter heights of nameplates and equipment number plates will be specified in detail in the requisitioning documents.



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15. **SELLER DOCUMENTATION**

- 10.1 Seller shall, as a minimum, provide all documentation as requested on the "Requirements for Documents" forms, which are an integral part of the requisition.
- 10.2 The rectifier system shall be shipped with an "As-built" set of schematics and installation, operating and maintenance instructions.



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