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**Functional Specification**  
**220V DC and 230/400V Distribution Boards**

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## 1 SCOPE

This Functional Specification is applicable for use in offshore wind transmission links delivered by the Customer as Contestable Works, to be owned and operated by EirGrid. The specification relates to the Onshore Compensation Compound.

This specification covers 220V DC, 230/400V AC and diesel back up/standby 400V AC distribution boards that are used for switching, protecting and monitoring auxiliary electrical supplies.

This specification should be read in association with the project specific contestable works pack and project documentation and all other relevant functional specifications as issued by EirGrid.

For the purpose of this specification the term Customer shall refer to Offshore Wind Power Developers, Independent Power Producers responsible for the design and build of assets to be handed over to EirGrid.

## 2 STANDARDS

The distribution boards shall comply with this specification and with the latest editions of the following standards:

ET 101:2000	National rules for electrical installations
IEC 60227	Polyvinyl Chloride insulated cables of rated voltages up to and including 450/750V
IEC 60309	Plugs, socket outlets and couplers for industrial purposes
IEC 60364-4-41	Electrical installation of buildings, Protection for safety, Protection against electric shock
IEC 60917	Modular order for the development of mechanical structures for electronic equipment practices
EN 60445:2021	Basic safety principles for man-machine interface, marking and identification – Identification of conductors by colours or numerals
IEC 60529	Classification of Degrees of Protection provided by Enclosures
IEC 60269	Low voltage fuses
IEC 61439	Low voltage switchgear and control gear assemblies
IEC 60529	Classification of degrees of protection provided by enclosures
IEC 60947	Low voltage switchgear and control gear
VDE 0641	Miniature circuit breakers

In case of conflict between this specification and any of the listed standards, this specification shall take precedence.

In addition, there shall be compliance with the provisions of all relevant directives of the European Union. In order to confirm compliance, the equipment shall carry the CE mark in accordance with directive 93/465/EEC.

### 3 RATINGS

The service voltages 220V DC in each case is to be rated voltage plus or minus 10%.

The rating for the AC supplies are identified in the OFS-SSS-400 specification (Section for Network Parameters).

#### 3.1 INSULATION LEVELS

The insulation between conducting parts to earth and between circuits shall withstand 2kV rms AC 50Hz voltages for one minute. Lower test voltages may be used if approved by EirGrid.

### 4 DISTRIBUTION BOARD REQUIREMENTS

There shall be adequate panel trunking and adequate cable access via M type glands into panels.

All circuits, including wiring, shall be rated according to IEC 61439.

When the board door is open IP2X minimum rating is required.

Duplicate 220V DC distribution boards shall be installed (see OFS-SSS-404). Main 1 Protection (Close & Trip No.1) will be fed from distribution board No.1, and main 2 Protection (Trip No.2) shall be fed from distribution board No.2.

Main 1 Power supply shall be fed from board No.1 & Main 2 Power supply shall be fed from board No.2.

Where there are hardwired interlocks are used, dedicated LV AC MCBs to be allocated for the interlocking circuits.

Supplies from distribution board no. 1 should be segregated and housed on separate cables from distribution board no. 2 supplies.

All distribution boards shall be of the fully enclosed type, manufactured to form 3b of Annex D according to IEC 60439, suitable for floor or wall mounting indoors. The distribution boards are to be separate units and shall be in separate locations (A fire in one doesn't lead to a fire in the other). The enclosure of each distribution board is to offer protection to minimum of IP41 standard.

The limiting height is 2250 mm and the minimum depth shall be 300mm. The required clearances between terminals and cable rails shall be maintained to safely dissipate the generated heat.

Bottom cable entries shall be used. Alternative arrangements may be used only through agreement with EirGrid.

Gland plates shall be adequately protected against corrosion either by painting or spray galvanising.

Doors giving access to MCB's or fuses shall be hinged and provided with individual handles and shall open through 180°. With any door open there shall be no access to live terminals of MCB's. All doors shall be earthed to the body of the distribution board by means of flexible earthing leads. Each door shall be capable of fitting a padlock to it;

proprietary locks shall not be fitted. The padlock shall have a diameter of 7 mm.

All cabinets shall have a degree of protection of IP41 according to IEC 60529.

The section of the board containing terminals and cable rails shall have removable covers.

All switches etc. are to be a suitable working height, i.e. not lower than 800mm and not higher than 1800mm from the floor. Switches shall not be mounted in such a manner that opening of cubicle doors requires removal of switch handles.

Terminal racks are not to be less than 400mm above floor level.

Cable fixing cleats on cable rails or an alternative method of supporting and fixing cables given on the drawings shall be provided. There shall be adequate board trunking and adequate cable access via M type glands into boards. An earth bar shall be provided for earthing of cable screens.

Facilities for connections to extend the board shall be provided.

## 5 EARTHING

A main copper earth bar shall be provided with minimum cross-sectional area of 95 mm<sup>2</sup>. It shall extend for the full length of the switchboard and have an external earth terminal suitable for connecting 95mm<sup>2</sup> copper conductor. The earth bar shall be located in the incoming/outgoing cable compartment. All accessible metal parts, such as cases of individual items, metal framework, etc. shall be bonded together and to the earth bar. The bar shall be fitted with sufficient clamp type terminals.

All doors shall be adequately earthed with flexible braid to the cabinet.

## 6 APPEARANCE

The boards shall be finished to colour RAL 7032 or the equivalent BS 4800 colour. All phase and neutral busbars and wires shall be colour-coded as follows as recommended by IEC 60445:

*Table 1 Cable Colours*

DC board		AC board	
+	Brown	R phase	Brown
-	Grey	S phase	Black
All others	Black	T phase	Grey
		Neutral	Blue
		All others	Black. Other colours can be used if approved by EirGrid
Earth	Bare and Green/Yellow as appropriate.	Earth	Bare and Green/Yellow as appropriate.

## 7 MISCELLANEOUS EQUIPMENT

### 7.1 MCB'S (MINIATURE CIRCUIT BREAKER'S)

The number of MCB's provided shall be dependent on the design and shall include additional 20% spares for future requirements. .

The MCB's shall be standardised as far as possible to facilitate interchangeability in order to reduce the number of spares.

MCB's shall be mounted inside the enclosure and be visible through a transparent window.

MCB terminals shall be easily accessible. There should be adequate spacing of MCB's in the vertical direction for ease of connection. There shall be a facility for attaching identification tags to the MCB's.

B/C/D characteristics should be used as specified by the design. MCBs shall have a rupturing capacity of 10 kA or higher.

Care shall be exercised during design such that MCB's are not rated higher than protection further upstream or lower than protection downstream.

#### 7.1.1 DC BOARDS

MCB's shall be suitable for DC operation and are to have B/C/D type tripping characteristics to IEC 60947. They shall be of the 2-pole type and have 2 auxiliary contacts, one auxiliary contact closes on fault tripping and one closes when the MCB is manually opened.

The MCB's must be supplied with a test function of the fault tripping auxiliary contact.

The MCB's shall be replaceable without powering down the board. A Risk Assessment and Method Statement for this activity shall be provided by the Customer to EirGrid for review.

Primary relays which have their own dedicated 220V DC MCB shall be 2A of C characteristic. All tripping circuits shall be 6A of B type characteristic. All other DC MCB's shall be adequately designed to meet its specific load requirements.

Note: For centralised busbar protection schemes, the DC MCB should be 6A C type whereas a 2A C type is satisfactory for de-centralised scheme. MCB's installed on 220V DC distribution boards must be rated for 250V DC.

If MCB's are polarised care should be taken to ensure that they are correctly fitted.

#### 7.1.2 AC BOARDS

The MCB's shall have thermal and instantaneous electromagnetic overload devices. B/C/D characteristics should be used as specified by the design. The MCB's shall have two auxiliary contacts, one auxiliary contact closes on fault tripping and one closes when the MCB is manually opened.

The AC board shall be suitably sized / designed to facilitate connection to at least three independent 3-phase AC supplies, which will be connected on separate set of terminals. See OFS-SSS-403 for auxiliary supply requirements.

The MCB's must be supplied with a test function of the fault tripping auxiliary contact.

## 7.2 MCCB'S (MOULDED CASE CIRCUIT BREAKERS)

The MCCB's shall be suitable for DC or AC operation depending on application. The poles of the MCCB shall be wired in accordance with the voltage application, to safely isolate the DC supply. They shall have two auxiliary contacts. One auxiliary contact closes on fault tripping and one closes when the MCCB is manually opened.

MCCBs should be capable for setting 70 – 100 % of nominal current for matching individual needs of feeders.

MCCB's shall have delayed thermal and instantaneous electromagnetic overload devices. They shall have a rupturing capacity of 16kA or higher, depending on the design.

MCCB's installed in 220V DC distribution boards must be rated for 250V DC. If MCCB's are polarised care should be taken to ensure that they are correctly fitted. MCCB's should be mounted inside the enclosure and be visible through a transparent window.

MCCB's shall be fitted with ARC protection to allow safe operation if the cabinet door is open.

MCCB terminals should be easily accessible. There should be adequate spacing of MCCB's in the vertical direction for ease of connection. There shall be a facility for attaching identification tags to the MCCB's.

## 7.3 TERMINALS/TRUNKING

The incoming supply terminals in the DC distribution boards shall each be capable of accepting one 35mm<sup>2</sup> conductor. All other terminals in the DC distribution board shall be capable of accepting 6mm<sup>2</sup> or 10mm<sup>2</sup> conductors each.

Terminals used for "MCB Open" signals are to be knife disconnect type terminals.

Terminals used for "MCB Trip" signals should not be of disconnect type.

Drawings should differentiate between the terminal types.

Please see annex A in the specification OFS-SSS-402 for details of all terminal's types, their function and representation symbols.

There should be adequate space, minimum 20%, for future terminals if extra MCB's are added.

The incoming supply terminals in AC distribution boards shall accept a 185 mm<sup>2</sup> lug and shall not be accessible from the section of the board where the output terminals are located. All other terminals shall accept 2 x 6 mm<sup>2</sup> conductor unless specified differently in the drawings.

Where there are two rows of output terminals, the terminals shall be arranged such that the location of one row does not impede the wiring or re-wiring of the other. Spacers should be used between phase t and neutral. Copper conductors equivalent to those used for phase terminals shall wire the neutral terminals to the neutral busbar. Minimum 20% spare terminals shall be provided in the terminal rack.

The layout of the terminals shall be subject to review by EirGrid. Terminals shall be suitable for the cables terminated onto the board. Signals shall be wired to a separate terminal block. Spare terminals (20%) shall be provided in the terminal rack.

To facilitate access, terminals are not to be recessed more than 25 mm from the front of the distribution board. Trunking of at least 150 mm x 100 mm shall be provided along the top of the cable fixing and up to and along the length of the terminal rack to accommodate the incoming cable cores.

Trunking shall be of sufficient size to cater for all cables associated with the distribution boards MCB's and any future MCB's.

## **8 INDICATION**

### **8.1 AC BOARD**

A digital voltmeter, 0-500V AC, 72mm x 72mm quadrant scale is required with voltage selection switch to enable r-s, s-t, t-r, r-n, s-n, or t-n voltage to be displayed.

Three 72 mm x 72 mm ammeters, one per phase on incoming supply, shall be provided. Ammeters shall be suitably rated. Ammeters should be 50Hz, 0-150A, and that the ammeters should be connected to CTs 150/1 A for each phase.

Meters shall be mounted at a height of approximately 1700 mm on ground mounted boards and centrally on wall mounted boards.

There should be no exposed live terminals on these voltmeters.

### **8.2 DC BOARD**

A 72 mm x 72 mm digital voltmeter, 0-250V for 220V shall be mounted on the front of the board at a height of approximately 1700mm.

There should be no exposed live terminals on these voltmeters.

### **8.3 BUSBARS**

For a metal clad board three phase and neutral busbars are required. For insulated construction an earth conductor must be provided.

Devices connected via RCD should use separate neutral and earth busbars. From separation point these busbars shall never be connected.

### **8.4 SWITCHES & FUSES**

All switches shall be load break switches, having at least the stated rating.

There shall be a facility for attaching tags/hold off notices to the switches.

Where relevant, main fuses shall be high rupturing capacity fuse links. All other fuses shall be DZ type.. All fuses shall be compatible with IEC 60269. On-load HRC fuse switches may be used in place of separate switches and fuses.

## **9 SIGNALS & ALARMS**

### **9.1 RESIDUAL CURRENT PROTECTION**

The residual current devices (R.C.D.) shall be of the current operated type with 30mA sensitivity.

### **9.2 PHASE FAILURE INDICATION (AC BOARD)**

Relays to detect undervoltage/phase rotation/phase failure and associated time delay signal relays are required.



### 9.3 OTHER DEVICES

Signalling relays should be able to make/break 10 a resistive load for at least  $1 \times 10^5$  cycles.

## 10 LABELLING

### 10.1 INTERNAL LABELS

All items are to be labelled with non-fade labels inside the distribution boards, according to the designations on the drawings of the distribution boards.

Equipment labels shall be made from Traffolyte material. The background shall be white, and the lettering shall be black. The lettering size shall be suited to the size of the label. The lettering shall be roman upper-case type.

Labels shall not be mounted on the item itself, or on the cable trunking covers - all labels shall be clearly visible not obscured by trunking or wiring. Terminals shall be labelled on both external and internal connection sides. Feeder terminals shall be labelled with respect to relevant MCB.

### 10.2 EXTERNAL LABELS

Adjacent to each switch or push button a label holder shall be provided to hold a text specified by design of minimum size 30mm high and 60mm long. This label shall be clearly visible when operating the switch or pushbutton.

Indication of closed and open positions of switches shall be indicated by text "on" and "off".

### 10.3 NAMEPLATES

A label holder, 50 mm × 135 mm, shall be provided on the front for the distribution board title.

The manufacturer shall provide a rating plate with the following information mounted visibly

On the exterior of the board:

Manufacturer's identification

- Board type designation, serial number, drawing number
- Rated operational voltage, rated frequency or indication "DC.", number of phases
- Utilisation category and rated operational currents. Maximal rated short circuit current.
- IP code
- CE sign

## 11 TYPE TESTS (FACTORY)

Inspection and routine tests shall be performed in the factory on each completed board. The distribution boards shall be tested to prove correct wiring and correct functionality of all components. The insulation withstand voltage shall be 2kV rms. Lower voltages can be used only if agreed with EirGrid. The results of all testing shall be submitted for review by EirGrid.

If a distribution board fails factory acceptance testing, rewiring and retesting will be required.

### 11.1 ROUTINE TESTS (FACTORY)

Factory testing may be witnessed by EirGrid. The following tests shall be carried out in the factory on each distribution board as minimum.

#### 11.1.1 GENERAL INSPECTION

This shall involve checks under the following headings:

- Dimensions, surface treatment, appearance and construction.
- Layout of equipment and markings.
- Type and rating of each item of equipment.
- Wiring and terminals – colour coding, identification, sleeves, neatness of arrangement, terminations, etc.
- Earthing.
- Markings, nameplates and labels.

#### 11.1.2 WIRING CHECK

Connections shall be checked for compliance with drawings.

Measurement of insulation resistance

The insulation resistance between conductor and earth of each circuit and between circuits shall be measured before and after the dielectric test by means of a 500V Megger. The insulation withstand test voltage shall be 2kV rms for 230V AC. Lower test voltages can be used only if agreed with EirGrid.

#### 11.1.3 DIELECTRIC TEST

The dielectric strength between conductors and earth of each circuit and between circuits shall be tested by applying AC 50Hz voltages of the magnitudes specified in section 4.1, insulation levels, for one minute.

#### 11.1.4 PERFORMANCE TESTS

Tests shall be carried out as appropriate in accordance with the relevant drawings:

1. Wiring continuity and circuit checks including earthing
2. Verification of instruments, relays, MCB's, fuses, etc.
3. Functional tests of equipment, if appropriate

4. Manufacturer's standard shop tests other than above.

## 12 DRAWINGS AND INFORMATION

### 12.1 TO BE INCLUDED IN DESIGN REVIEW

The following information shall be supplied with the design for review by EirGrid.

1. Full technical specification of each item proposed.
2. Reports of type and routine test according to IEC61439.
3. List of deviations.
4. Final dimensioned drawings of the complete board showing the layout of the individual items shall be provided.
5. Layout and location of distribution boards.
6. Construction details of each cabinet and layout of equipment.
7. Technical details of meters
8. Detail schematic diagrams of each dc supply, its distribution and supervision, with accompanying description.
9. Detail schematic diagrams of each ac supply, its distribution and supervision, with accompanying description.
10. Physical arrangement of equipment both internally & externally.
11. Proposed cable type, size, routes and terminations.
12. Details of conduit or trunking to be used shall be included
13. Details of protection studies covering all auxiliary power circuits. Both overload and short circuit conditions shall be considered and the co-ordination of suitable MCB or fuse characteristics with load type and size and cable size shall be clearly demonstrated.
14. Wiring diagrams, cable schedules and list of apparatus shall be submitted to EirGrid for review not later than three months before commencement of installation.
15. Technical schedules
16. Basic schematic diagram of each DC supply, its distribution and supervision.
17. Basic schematic diagram of each AC supply, its distribution and supervision.