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**Functional Specification**

**Auxiliary Cables and Wiring System**

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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 Compounds (OCC) and Offshore Substation Platforms (OSP) .

This Specification covers the supply, testing and delivery of LV multicore control cables with copper conductors, PVC insulation, copper screen (where applicable) and PVC sheathing as well as LV auxiliary power cables.

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 cable supplied under this specification shall conform to and be tested in accordance with this specification and with the latest editions of the following standards:

IS 201:2001	Polyvinyl Chloride (PVC) insulated cable and flexible cords of rated voltage up to and including 450/750V.
IEC 60189	Low frequency cables and wires with p.v.c. insulation and p.v.c. sheath.
IEC 60227	Polyvinyl chloride insulated cables of rated voltages up to and including 450/750V
IEC 60502	Extruded solid dielectric insulated power cables for rated voltages from 1kV up to 30kV.
IEC 60811	Common test methods for insulating and sheathing materials of electric cables.
IEC 60228	Nominal cross-sectional areas and composition of conductors of insulated cables
IEC 60331	Fire-resisting characteristics of electric cables.
IEC 60332	Tests on electric cables under fire conditions.
IEC 60885	Electrical test methods for electrical cables.
BS 6234	Specification for polyethylene insulation and sheath of electrical cables.

Where a particular subject is not covered by one of the above standards then a recognised national or IEC standard shall apply.

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 relating to work equipment, i.e. in regard to safety of personnel who operate and maintain equipment. In order to prove compliance, the equipment shall carry the CE Mark in accordance with Directive 93/465/EEC.

### 3 ENVIRONMENTAL CONDITIONS

The cables shall be suitable for indoor and outdoor use, and may be buried in the ground, installed on cable trays / racks, laid in ducts and/or submerged in water.

The cable shall be suitable for indoor and outdoor operation at a height of 0-1000 metres above sea level in salt-laden, damp, polluted atmosphere with heavy rain. The cable shall be capable of operating normally within the following temperature range:

Maximum Air Temperature: +40 °C (Degrees Celsius).

Minimum Air Temperature: -25 °C (Degrees Celsius).

The cable shall be capable of operating in electrically exposed locations also where high humidity (65% to 100% relative humidity) and dew point are commonplace.

### 4 GENERAL

The cables supplied under this Specification are intended for connection to Instrument Transformers, Measuring Instruments, Control and Relaying Equipment.

Working Voltage AC 110V, 230V, 400V.

Working Voltage DC 24V, 48V, 220V.

Voltage Class Uo/U 0.6/1kV.

Cable types include screened multicore and screened/unscreened multiple twisted pair cables.

Screened multicore cables shall be used for all outdoor circuits and for all circuits involving voltages greater than 50V. The use of unscreened cable for any particular application is subject to EirGrid review.

Conductor cross-section shall be rated for the relevant current-carrying capacity duty. The Customer shall ensure that the cross-section of the wiring is adequate for the operating current, maximum short-circuit current, duration and voltage conditions.

The screens of screened cables shall be connected to the earth grid at both ends of the cable by the shortest practical connection.

Each multi-core/multi-pair cable shall be used for one type of duty for example, a cable used for connections to instrument transformers shall not include connections to switchgear operation.

Instrument transformer secondaries shall be segregated i.e. shall use dedicated cables and where possible should be installed in dedicated trenching / trunking systems.

Each multi-core/multi-pair cable shall be used for one battery voltage only, batt1 and batt2 cables shall be segregated in separate trunking systems

Cable use shall also be on a switchgear bay basis where possible (dedicated to a specific function for a specific bay). This requirement shall be reflected right through the station including control rooms.

Cables and wires for any particular circuit shall have a dielectric test level at least matching the minimum level of the equipment to which it is connected and rated duty at least equal to that of the equipment to which it is connected.

Wires and cable cores of circuits with different voltage ratings shall be segregated unless they are rated for the higher voltage rating.

AC and DC circuits shall not be carried on the same cable. Cables shall be fitted with numbered permanent identification tags at termination points. Suitable glands shall be used to connect cables to mechanism boxes, cabinets etc.

Typically, 25mm<sup>2</sup> or 35mm<sup>2</sup> PVC double insulated single core cables are used for the connection from battery to battery charger. As above, conductor cross-section shall be rated for the relevant current-carrying capacity duty and maximum short-circuit current, duration.

#### **4.1 ROUTING AND ARRANGEMENT**

Cable routes shall be chosen so as to minimise the pick-up of induced voltages liable to cause damage or interference and also to minimise the length of the circuits

The Customer to ensure that the routing and arrangement of cables shall be planned to provide an orderly formation, free from unnecessary bends and crossings, which will permit the removal of any one cable without undue disturbance to adjacent cables.

At least 20% spare space in cable trays, trucking, ladders, trenches, etc. shall be provided.

Cables shall be installed so that no temporary or permanent bends are made which are sharper than those recommended by the cable manufacture and confirmed as acceptable by tests. There shall be no joints in LV cables laid entirely within the substation.

Where cables entering the control building or pass from room to room within a building, fire retardant barriers shall be provided as per fire design requirements.

#### **4.2 LAYING OF CABLES**

Cables shall not be laid directly in the ground but, shall be laid in reinforced concrete troughs with removable covers, alternative material for the LV cable troughs can be considered by EirGrid but needs to match the strength and resistance of the concrete. This type of trough shall be used for cables exiting the building and running with the station yard between it and each bay.

The type and method of removing the covers shall be agreed with EirGrid and depends on the weight of each cover slab.

In addition to the main artery troughs, pipe ducting shall be used from the cable trough to each item of plant within each bay.

Cable ducts to HV plant shall be directly encased in the concrete plinth for each item of Plant. On exiting, the duct shall be suitably located within the concrete plinth so as to minimise the length of exposed cable to the equipment. The Customer shall ensure that the cable is appropriately supported by means of metal cable tray along its exposed length to ensure secure support and to prevent damage.

The pipe ducts shall be buried at a minimum depth of 600mm.

Where cables are run across roads or enter buildings the cables shall be run in concrete encased pipes in consideration of the possible vehicle weight and mechanical stress that could be applied to the pipes.

All pipe ducts shall be brushed clean immediately prior to installation of cables. The Customer shall deal with and dispose of water and other extraneous materials so as to avoid risk of damage to cables.

The pulling arrangements for cable installation shall be subject to EirGrid review.

The cable shall where necessary, be lubricated to facilitate drawing in. The lubricant used shall have no deleterious effect on the cables or other surrounds and not harmful for the human beings. At the point of cable entry into the pipe or duct, a bell mouth of suitable soft material shall be provided to prevent damage to the cable during installation.

Suitable barriers shall be provided where control cables enter the control building to prevent ingress of vermin, animals and water, Rotex<sup>1</sup> or similar is preferred Indoor cables shall be run under false floors or in ducts in the floors, the ducts shall have removable covers.

Indoor cables, which are run above floor, shall be supported by suitable metal trays or racks. Protective covers shall be placed over trays etc. where the cables may be exposed to damage from falling material or moving equipment.

Where cables enter a building or pass from room to room within a building fire retardant barriers shall be provided as per fire design.

All cable routes shall be clearly marked with identification and warning labels where appropriate.

## 5 MATERIALS

The conductor shall be un-tinned copper complying with IEC 60228. The insulation and sheath shall consist of a thermoplastic material based on PVC complying with the requirements of IEC 60502, IEC 60811 and IEC 60885.

### 5.1 CORROSION ACTION

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<sup>1</sup> <https://www.roxtec.com/uk/about-us/cpd-continuing-professional-development/sealing-in-substations/>

Every precaution shall be taken to ensure that cables and accessories are not installed in a manner or under conditions likely to cause electrolytic or other corrosive action or damage to or be detrimental to the performance of the cables during operation.

## 6 SUPPORTS

The Customer shall supply and install all the supports, racks, trays, cleats, saddles, clips and other parts required to carry and secure the cables without risk of damage, in a neat and orderly manner.

Support structures for cables shall be free from rough edges and sharp corners. If such support structures are of mild steel, they shall be Hot-dip galvanised.

Cable connections to kiosks, boxes, cabinets etc. shall be at least 300mm over ground. Vertical portions of cable runs shall be supported by clamps, saddles on ladder racking or in conduit or trunking. All cables shall be securely supported at a point not more than 1.0m from their terminations.

## 7 JOINTING

Jointing of the conductors shall only be acceptable where the electrical and mechanical characteristic of the joint matches those of the conductors (e.g. fusion process). Spliced soldered joints are not acceptable.

## 8 CABLE DETAILS

### 8.1 SIZES

For the control and auxiliary power cables, the cable sizes shall be as follows

1. 4 x 1.5mm<sup>2</sup>
2. 7 x 1.5 mm<sup>2</sup>
3. 12 x 1.5 mm<sup>2</sup>
4. 19 x 1.5mm<sup>2</sup>
5. 4 x 2.5mm<sup>2</sup>
6. 4 x 10mm<sup>2</sup>
7. 4 x 6mm<sup>2</sup>
8. 4 x 4mm<sup>2</sup>.

Any cables with core size of 1.5mm<sup>2</sup> shall be single stranded; those cables with core size greater than 1.5mm<sup>2</sup>, i.e. 10mm<sup>2</sup>, 6mm<sup>2</sup> and 4mm<sup>2</sup> shall have between 4 and 7 strands.

AC power cables should be sized according to the latest edition of IS 10101.

IS 10101:2020 replaced ET 101:2008 on the 6<sup>th</sup> March 2020

## 8.2 PVC COLOUR

The core insulation for multi-core control cable shall be yellow. The sheath colour shall be black.

Other colours can be used subject to EirGrid review and approval.

## 8.3 CORE IDENTIFICATION

Core identification of control cables shall be by numbers. The numbering, which shall be both in figures and words, shall be printed clearly and permanently on the insulation of each core at intervals of not more than 50mm. The figures and lettering shall not rub off under conditions of normal handling.

The preference is to use the bay number in the cable identifier.

Figures should be a minimum of 3mm high, and the colour preference is black on yellow insulation. Cores shall be numbered as follows:

- 4 Core cable - Nos. 1, 2, 3 and 4.
- 7 Core cable - Centre core, No. 1. 6 cores around centre, Nos. 2 to 7.
- 12 Core cable - Centre 3 cores, Nos. 1, 2 and 3. 9 cores around centre, Nos. 4 to 12.
- 19 Core cable - Centre core, No. 1. 6 cores around centre, Nos. 2 to 7. 12 outer cores, No. 8 to 19

Core Identification for multiple twisted pair cable may be carried out by means of a recognised colour coding system as referenced in EN 60446.

Colour coding of LV power cable cores shall be compliant to IEC standards.

## 8.4 CABLE MARKING

The cable sheath shall be clearly embossed with raised lettering of height not less than 20% of the overall diameter of the cable. Embossing shall be at intervals of not more than one metre with the following data:

Electric Cable, 600/1000 Volts, size designation e.g. NYCY (NYCWY) 4 x 6mm<sup>2</sup>, manufacturers name (or trademark), year of manufacture.

In addition, the cable outer sheath shall be sequentially marked in metres so that when a length of cable is removed from the drum/coil, the remaining length can be easily determined.

Each cable shall be marked from zero up to the specified drum/coil length.

## 8.5 LAYING UP AND COMMON CORE COVERING

A layer of thermoplastic material shall be extruded over the laid-up cores and under the sheath. The filler shall be resilient, homogeneous, preferably of a different colour to sheath and core insulation and must not adhere to the core. Alternatively, a rubber-based material or a wrapping of fabric or plastic tapes may be substituted for the extruded common covering.



## 9 SCREENING (APPLICABLE TO SCREENED CABLES)

The cables shall have a copper screen over the common core covering. The cable screen in all cases shall consist of two layers, an inner layer of plain annealed copper wires and an outer layer of copper tape laid on helically with an overlap of 20%. The cross-sectional area of the inner layer of the screen (plain annealed copper wires) shall be as follows:

*Table 1 - Control Cable Cross Sectional Area*

No. of Cores	Screen Cross-Sectional Area
Under 12	equivalent to core cross-section
12 and under 19	not less than 2.5mm <sup>2</sup>
19 and over	not less than 4mm <sup>2</sup>

## 10 FIRE RETARDATION

In addition to the requirements of the individual IEC Publications for each cable type with regard to fire retardation, all cables shall satisfy the requirements of IEC 60331 and IEC 60332.

Fire resistant cables shall be used for services that are critical and need to remain in operation during fire (for example fire detection and protection).

## 11 TESTS AND INSPECTION

All type tests and routine tests on each type and size of cable shall be carried out in the factory in accordance with applicable standards as listed in this Specification.

Before dispatch each drum of cable shall be routine tested in accordance with IEC Publications. EirGrid may choose random sample lengths of any or each size/type of cable and instruct the Customer to submit a full set of type test reports.

The Customer shall in all cases send to EirGrid for review soft copies of the routine test certificates, covering each drum of cable offered for acceptance.

Details of the proposed routine testing shall be included with the tender. Before carrying out routine tests on any consignment of cable, the Customer must give sufficient notice to EirGrid for inspection and to witness tests being carried out.

## 12 PACKING AND LABELLING

Cable drums and the outer transport covering shall be of adequate strength to protect the cable from damage during transport and storage on site. The surface and rims of the drums shall be smooth and free of any protruding edges to prevent damage to the cable. The ends shall be sealed securely against the ingress of moisture and water.

## **13 INFORMATION TO BE INCLUDED WITH INITIAL SUBMISSION**

### **13.1 TO BE SUBMITTED AS PART OF DESIGN REVIEW:**

- 1 Fully completed copy of the technical schedules.
- 2 Detailed dimensional drawing of each type of cable.
- 3 Details including Certificate of Type Tests carried out on each type of cable.
- 4 Detailed report covering all routine testing carried out on each type of cable.
- 5 "Schedule of Deviations from Specification". Information in specific terms of any parameter(s) specified herein, which the scheme offered does not meet, quoting the relevant clause number(s) of this specification.
- 6 Details of manufacturer's Quality Assurance Policy/Programme/ Certification shall be submitted.
- 7 Layout and detail drawing of cable trays.
- 8 Drawings showing details of cable terminations including supports, terminals, glands, earthing screened cables etc.
- 9 Complete cable schedule giving cable type, size, locations and labelling system
- 10 A cable routing layout/elevation drawings showing all cable runs with numbers of cables on cables trays etc.

### **13.2 TO BE SUBMITTED BEFORE STATION HANDOVER**

Before the substation is handed over to EirGrid, the Customer shall submit drawings and information giving details of the following

- 1 Final records of routes
- 2 Details of terminations
- 3 Records of all testing carried out