Base Load Power Hub (BLPH)

Instrument Cables Specification

Document Number: 123A90-DDL-IN-SP-40067

Document Class: 2

01	18/09/2024	Accepted for Construction (AFC)	VBA	LCA	DLO
00	25/03/2024	Issue for Review (IFR)	VBA	LCA	DLO
Rev.	Date	Description	Prepared	Reviewed	Approved

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Revision / Change Log

Rev.	Description
00	Issue for Review (IFR)
01	Accepted for Construction (AFC)

HOLDS LIST

No.	Description
1	
2	
3	
4	

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1. INTRODUCTION

1.1. PROJECT OVERVIEW

Crosswind, a Shell and Eneco joint venture, was awarded the tender to develop the offshore Hollandse Kust Noord (HKN) wind farm, located 18.5km off the coast of Netherlands near the town of Egmond aan Zee. The consortium plans to have HKN operational in 2023 with an installed capacity of 759MW generating at least 3.3TWh per year. This is sufficient renewable power to supply more than 1 million Dutch households with green electricity.

Offshore wind farms produce intermittent electricity and balancing these dips and peaks and integrating this electricity into the national energy system requires new technologies. For this reason, the offshore wind farm will include several new technologies that could be implemented at full-scale in the future. The new technologies being explored include a floating solar park, a short-duration battery storage as well as long-term storage via green hydrogen produced by water electrolysis and subsequently consumed in a fuel cell. The combination of these individual measures, herein referred to as the Base Load Power Hub (BLPH) will ensure a continuous power supply regardless of the wind situation.

1.2. Project Location

The Hollandse Kust Noord (HKN) wind farm is located 18.5km off the coast of the Netherlands near the town of Egmond aan Zee.

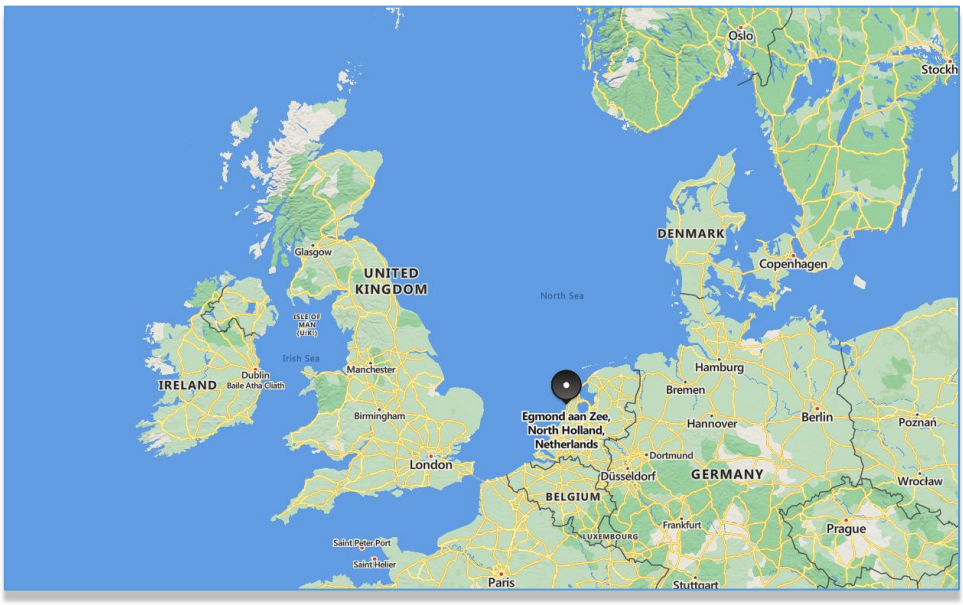


Figure 1 - HOLLANDSE KUST NOORD WIND PARK Location Map

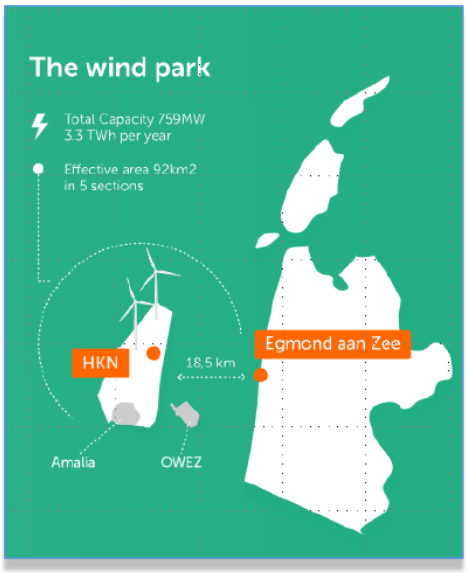


Figure 2 - Wind Park Details

The wind farm will consist of No. 69 x 11.5MW wind turbine generators each to be installed on a dedicated monopile structure. A 70th monopile located on coordinates E 590719.1, N 5841602.3 is reserved for installing the platform accommodating the BLPH. The monopile structure was designed and installed by Van Oord Offshore Wind (VooW) and therefore not part of the BLPH scope.

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1.3. Project Concept

All components included in the BLPH will be integrated onshore on a topsides and installed in an offshore location within the boundaries of the HKN wind farm. At its simplest, the BLPH will store energy during periods of high electricity generation from renewable sources (a wind turbine generator and the floating solar PV farm) and release it during periods of low generation. In practice. It is expected that the energy stored will supplement generation from renewable sources to ensure that at least 1.0MW of power is exported to the electrical grid regardless of wind/solar availability.

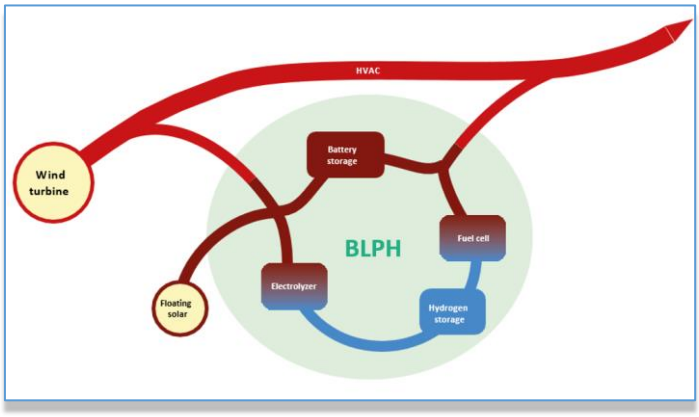


Figure 3 - BLPH Concept

Electricity in the BLPH will be stored in the form of electrons in a battery energy storage system (BESS) as well as converted into green hydrogen via water electrolysis. When the power output from the connecting wind turbine drops to below 1 MWe, the BLPH will return its stored energy to supplement the remaining power output. This will be by discharging the BESS, while stored hydrogen will be converted back into electricity using a fuel cell to extend the discharge duration.

The purpose of the BLPH s to function as a testbed for the integration of energy storage technologies with renewable generation. It is expected that equipment installed on the BLPH will operate as Normally Unmanned Installation for at least two (2) years with no or minimal maintenance and it will have its own independent control room with the ability to communicate with Crosswind's control room.

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2. DOCUMENT SCOPE

The purpose of this document is to defines the minimum requirements for the Instrumental cables to be installed on the BLPH.

Single cables are used to connect field instruments to field mounted junction boxes.

Multicore cabling subsequently connects the junction box to a marshalling cabinet or system cabinet in the control room (ITER).

2.1. REFERENCES

Doc. No.	Description
123A90-DDL-IN-SP-40094	Instrumentation for Package Unit Specification
123A90-DDL-IN-DS-40064	TDS – Instrument Cables
123A90-DDL-IN-LIS-40091	Instrument Cable List

Table 1 - Reference Documents

2.2. DEFINITIONS AND ABBREVIATIONS

COMPANY or Client (CPY):	CROSSWIND
CONTRACTOR (CTR):	ROSETTI MARINO S.p.A.
PROJECT:	HOLLANDSE KUST NOORD WIND PARK Project
BLPH	Base Load Power Hub
CAT	Category
DEM	Design Engineering Manual
IS	Intrinsically Safe
ISO	International Organization for Standardization
ITER	Instrument & Telecoms Equipment Room
NIS	Non-Intrinsically Safe

Table 2 – Definitions and Abbreviations

3. APPLICABLE CODES, STANDARDS, AND REGULATIONS

3.1. GENERAL

The equipment shall be designed, manufactured, tested, and delivered in accordance with this philosophy and the Project documents, codes, standards, and regulations listed below. It is the Vendors responsibility to ensure complete compliance in their design, inclusive of all sub-vendors. The normative documents listed below contain requirements that, through reference in this text, constitute the requirements of this Project. Latest editions of all referenced documents shall apply.

The following requirements shall apply as a minimum with the design being fit for purpose for the technical requirements listed in section 4.

The project shall apply relevant standards and codes in the following order:

1. Dutch Standards and Regulatory Requirements
2. Selected DEM-1 and DEM-2 requirements.
3. Industry Codes and Standards.

The codes, standards and specifications referenced in this specification shall be taken to mean the latest edition and addenda. It is not a definitive list and does not preclude the use of other Codes if approved in writing by CONTRACTOR.

In case of conflict between this specification, other referenced specifications and the codes and standards, this shall be brought to the COMPANY's attention for resolution in writing. In all cases the most stringent requirements shall apply.

3.2. EXTERNAL, INDUSTRY AND/OR VENDOR STANDARDS

IEC/TR 61000-5-2	Earthing and Cabling – Installation & mitigation guidelines
IEC 60079-14	Explosive atmosphere -Electrical installations, design, selection & erection
EN 50288-7	Multi- element metallic cables used in analog and digital communication and control
IEC 60502-1	Power cables with extruded insulation and their accessories for rated voltages from 1 kV up to 30 kV.
IEC 60228	Conductors of insulated cables

EN 50290-2-27	Communication cables - Common design rules and construction - Halogen free polyolefin based sheathing compounds for cables having improved flame and fire properties (HFFR)
EN 50290-2-24	Communication cables - Common design rules and construction - Polyethylene sheathing compounds
IEC 60304	Standard colours for insulation for low-frequency cables and wires
IEC 60332	Tests on electrical and optical fiber cables under fire conditions
IEC 60331	Tests for electric cables under fire conditions – circuit integrity
IEC 60092-376	Electrical installations in ships – Cables for control and instrumentation circuits 150/2150V (300V)
IEC 60079 -14	Electrical Apparatus for Explosive Gas Atmospheres.
IEC 61892	Mobile and fixed offshore units – Electrical installations
IEC 61000-4-4	Electromagnetic compatibility (EMC) – Testing and measurement techniques – Electrical fast transient/burst immunity test
IEC 60793-1&2	Optical fibers - Part 1: Generic specification - Section 2: Measuring methods for dimensions
IEC 61034-2	Measurement of smoke density of cables burning under defined conditions - Part 2: Test procedure and requirements
IEC 61280-4-1-9	Fiber-optic communication subsystem test procedures – Part 4-1: Installed cable plant – Multimode attenuation measurement
ISO 9001	Quality Management
ISO 9002	Quality System

Table 3 – External, Industry and/or Vendor Standard

4. CABLE TECHNICAL INFORMATION

4.1. GENERAL

In general, all outdoor cables (single or multi-pair/triad/cores) will be provided with Steel Wire Braided (SWB) armor.

Outer sheath shall be suitable for above ground installations (mainly in cable trays; sometime in open conduit, where necessary) in Marine environment.

Single cables (pair, triad or dual cores) will be used to connect field instrumentation to the relative Junction Boxes or, in some cases, to connect the field instruments to the proper Control or Safety system.

Multi-pair, muti-triad or multi-cores cables will be used to connect the field Junction Boxes to the related Control or Safety Systems installed inside the Instrument & Telecoms Equipment Room (ITER).

The detailed characteristics of the project cables are shown in the following paragraphs.

4.2. CABLE CONSTRUCTION

All cables shall be provided with the following construction design:

1. All the Instrument cables shall be of proven design and suitable for operation in a marine environment.
2. Instrument cable shall be constructed in accordance with EN 60092-376.
3. The insulation material shall be cross linked Polyethylene applied to comply with EN 60228.
4. Outer sheathing shall be a Low Smoke Zero halogen (ZSLH) compound to EN 50290-2-27.
5. Inner sheathing shall be a Low Smoke Zero halogen (ZSLH) compound to EN 50290-2-27.
6. Cables used aboveground in the plant shall be protected with steel wire braiding (SWB) even if they are used in cable trays.
7. The intrinsically safe cables shall be blue in colour outer sheath.
8. NIS (non-IS) cables shall have GREY colour for outer sheath in case of Control System (DCS) signals and ORANGE colour in case of Safety System (SIS/FGS) signals.
9. All Control System cables shall have FLAME RETARDANT sheath in accordance with IEC 60332.
10. All Safety System cables shall have FIRE RESISTANT sheath in accordance with IEC 60331.
11. Cables shall be supplied in the following standardized number of pairs and cores as recommended by IEC 60092-376.
    - Pairs, triples or quads: 1, 2, 6, 12.
    - Cores: 2, 12, 24.

12. Instrument cables shall be as a minimum rated voltage Uo/U (Um) = 150V/250V (300V) according to IEC 60092-376.
13. Conductors shall be stranded, tinned, circular copper wire according to IEC 60228 class 2.
14. The cable core **minimum** size recommended for various signals are given below.
    - Analog signals (4-20mA) – 0.75 mm^2
    - Digital inputs (NAMUR, Dry Contact) – 0.75 mm^2
    - Digital output (Solenoid valve, General visual alarm) – 2.5 mm^2 (field cables)
    - Gas detector / Flame detector - 2.5 mm^2 (field cables)
    - Conductors' nominal cross-sectional area shall be as follows:
        - In Single pair/triad cables
        - 0.75 mm^2 for all analogue, discrete (on/off) input and thermocouple signals.
        - 2.5 mm^2 for Solenoids valves, Gas Detector and Flame Detector
        - In multi-pair/multi-triad/multi-core cables
        - 0.75 mm^2 for all analogue, discrete (on/off) input and thermocouple signals
        - 2.5 mm^2 minimum for all discrete (on/off) outputs, command, solenoid valve;
        - 2.5 mm^2 for Solenoids valves, Gas Detector and Flame Detector

For the cables Characteristic and Sizes refer to project document "TDS – Instrument Cables" n° 123A90-DDL-IN-DS-40064.

4.3. CABLE COLOUR

Outer Sheath Colours

The following colours shall be used:

- Flame retardant type (non-intrinsically safe) Grey
- Fire resistant type (non-intrinsically safe) Orange
- Flame retardant (intrinsically safe) Blue
- Fire resistant (intrinsically safe) Blue

Core/Pair Colours shall be in accordance with relevant IEC.

4.4. OPTICAL FIBER

Optical fiber will be used to connect platform control equipment with external systems (other platform or on-shore plants).

The Manufacturer/Supplier shall advise the minimum performance requirements of the fiber optic connections that are not within their scope of supply.

The Contractor shall test fiber optic connections to prove that the requirements of the Manufacturer/Supplier are met.

Optical fibers and connectors shall be standard and comply with the requirements specified in IEC 60793-1-1, amended as follows:

a. by ITU-T G.651.1 for multimode graded index fibers;

b. by ITU-T G.652 for single-mode fibers.

Cables incorporating optical fibers shall comply with IEC 60794-1-1.

Splices shall not be used.

Connectors shall only be used to connect equipment and in patch panels.

The fiber type to be used shall be suitable for the distance to be spanned and the protocol to be used.

For the Fiber Optical cables Characteristic and Sizes refer to project document "TDS – Instrument Cables" n° 123A90-DDL-IN-DS-40064.

4.5. OPTICAL FIBER COLOURING

Optical cables shall have ORANGE colour outer sheath for multi-mode and YELLOW for single-mode.

The colouring and marking shall be unambiguous so that it is possible to identify all the optical fibers within each loose tube in a 300 mm (12 in) length of optical cable core, provided that each loose tube is coded.

Colour coding of optical cables shall be permanent.

4.6. FTP CAT 6A CABLES

FTP CAT 6A cable shall be used for the communication applications (PROFINET, Modbus TCP-IP, EtherNet/IP) between different systems and shall follow the requirements specified in o IEC 61156-5 Category 6A, EN 50288-10-1 and ANSI TIA 568-C.2 Cat.6A.

Outer sheath shall be Low Smoke Zero Halogen (LSZH) according to IEC 60754-1 and FLAME RETARDANT as per IEC 60332.

All FTP-CAT6A cables shall be provided with SWB armour and shall be suitable for above ground installations in Marine environment.

Cable configuration shall be 4x2xAWG23, twisted pair and all conductors shall be RJ45 plug compatible.

For the CAT 6A cables Characteristic and Sizes refer to project document "TDS – Instrument Cables" n° 123A90-DDL-IN-DS-40064.

4.7. FTP CAT 6A COLOURING

CAT 6A cable shall have GREY colour outer sheath.

Conductors colour coding shall comply with the following standard:

- (1) blue/white,
- (2) orange/white,
- (3) green/white,
- (4) brown/white.