Base Load Power Hub (BLPH)

Insulation Specification

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Revision / Change Log

Rev.	Description
00	Issue for Review (IFR)
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HOLDS LIST

No.	Description
1	Resolved - Personnel Protection will not be specified
2	Resolved - Length of insulated nozzles and man-ways shall be sufficientely sized
3	Resolved – Suitable AF/ARMAFLEX system for instruments and tubing
4	Resolved – No Personal Protection is requried

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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.

1.1.1 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.

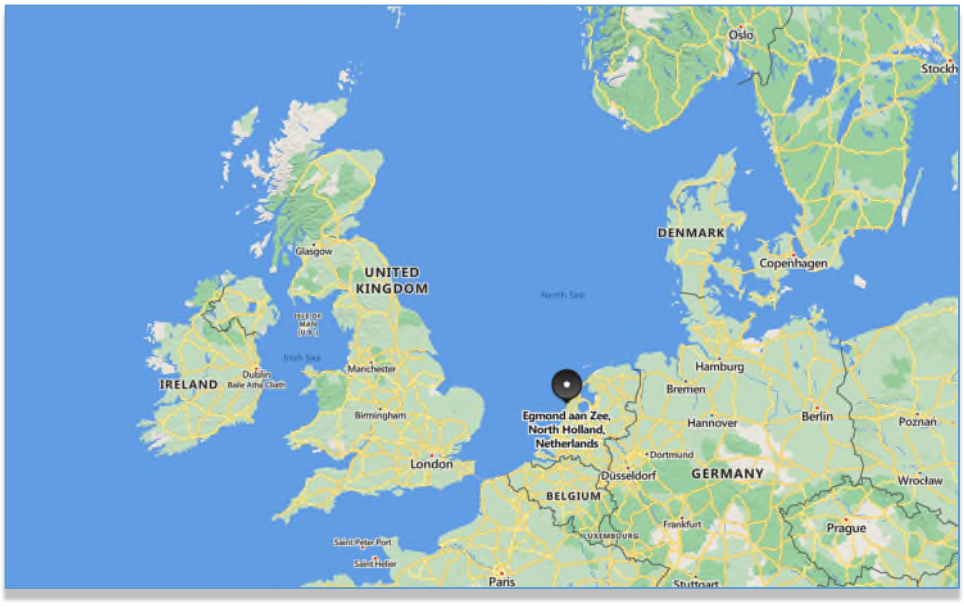


Figure 1 - HOLLANDSE KUST NOORD WIND PARK Location Map

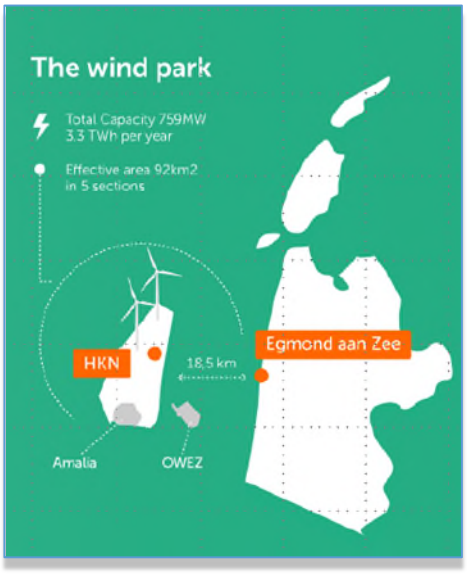


Figure 2 - Wind Park Details

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.

1.1.2 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.

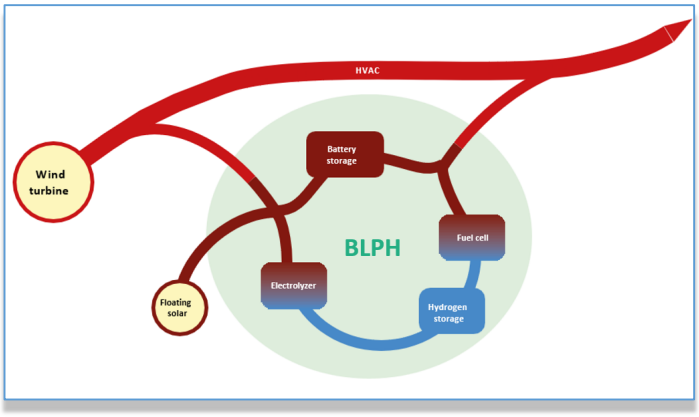


Figure 3 – BLPH Concept

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 specification is to define the minimum technical requirements of the Hollandse Kust Noord Wind Park Project for the selection and the execution of the following-

- Insulation Heat Conservation (H) on piping and valves. The purpose of Heat Conservation is to reduce heat losses and to maintain temperatures for the efficient operation of the process.
- Electrical Heat Tracing (E) on piping and valves. The purpose of Heat Tracing is to provide to the system a continual thermal heat to ensure the service remains at a constant temperature and is free-flowing,
- Personal Protection (P) on piping and valves is not required based on design temperatures and will not be specified.

The scope of this document covers thermal insulation only. In general insulation, insulation for skid mounted packages will be the manufacturer prior to shipment.

2.1 REFERENCES

Doc. No.	Description
[1] K559-2254-PM-PLN-003	Basic Design Engineering Package
[2] 123A90-DDL-MAT-RE-60011	Material Selection Report
[3] 123A90-DDL-MAT-SP-60006	Coating and Painting Specification
[4] 123A90-DDL-PP-SP-70000	Piping Material Classes
[5] CWHKN-INN-BPH-DTS-00005	BLPH Platform Site and Engineering Data
[6] 123A90-DDL-PR-RE-80032	Insulation and Winterisation Philosophy

Table 2-1 - 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

Table 2-2 - Definitions and Abbreviations

3 STANDARDS, CODES AND GUIDELINES

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.

Document Number	Document Title
ASME B31.3	Process Piping
EN 14303	Thermal insulation products for building equipment and industrial installations – Factory made mineral wool (MW) products
EN ISO 12241	Thermal insulation for building equipment and industrial installations - Calculation rules

Table 3-1 - List of codes and standards

3.1 DEVIATIONS

Any deviations from the requirements stated within the Requisition, and the documents and specifications referenced within the Requisition (including this specification and all attachments), shall be submitted in writing to the CONTRACTOR's for approval, with the SUPPLIER's bid. It shall be assumed that if deviations are not listed, then the SUPPLIER's bid shall be fully compliant.

4 DESIGN REQUIREMENTS

4.1 INTRODUCTION

The topside facility shall be designed for a minimum operating life of 2 years.

Surface preparation prior to insulation on piping, valves, flanges shall be in accordance with Ref. [3] 123A90-DDL-MAT-SP-60006.

All materials, or combination of materials are stated in Sect. 4.8.

4.2 INSULATION SUPPLIER

The SUPPLIER shall establish a document containing all insulation details, including removable jackets for valves and flanges, and present this for CONTRACTOR's approval prior to the supply of insulation materials and equipment and the start of insulation work. The insulation SUPPLIER shall also supply insulation materials and provide project management services to CONTRACTOR.

4.3 HSE

Approved HSE product data sheets shall be available for all materials. All materials shall comply with applicable health and safety regulations both in the country where the insulation is applied and the country where the product is to be used. All products shall be approved by CONTRACTOR.

4.4 GENERAL DESIGN

In accordance with Ref. [6] CWHKN-INN-BPH-DTS-00005 all the relevant ambient conditions of the facility are defined.

Piping shall be insulated where stated on the line list, P&IDs and isometrics for piping.

All insulation shall be covered with weather protection designed and installed to prevent ingress of water during normal operation throughout the project design life.

Insulation adjacent to flanges in piping shall be terminated to allow removal of bolts without damage to insulation. Minimum free space from the flange to the nearest part of the insulation shall be equal to the bolt length + 25mm. The termination of the weather protection shall be waterproof.

The insulation material shall be non-combustible in accordance with EN ISO 12241.

The insulation design shall allow the necessary room for insulation and insulation jacket. Particular care shall be taken in piping design to ensure sufficiently long straight runs around e.g. branches, bends, valves and supports, to enable proper installation of insulation.

The following shall as a minimum be considered during design:

- The space between the outside diameters of insulated pipes in adjacent pipe runs shall be a minimum of 50mm.
- When insulated piping is routed parallel to structural steel, bulkheads or walls the distance

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between the outside diameter of the insulated pipe and steel, bulkhead and wall shall be a minimum of 50mm.

- The distance between removable insulation jackets and surroundings, including pipe branches, bends etc. shall be a minimum of 100mm.
- Length of pipe branches shall be sufficient to allow for pipe insulation and sealing and, if insulation of the branch is required, allow for the insulation and jacketing to be terminated and sealed independently of the flange insulation.
- The stand-off length of vessels ancillary attachments such as ladders, stairways, level controls etc. shall allow for the insulation and jacketing to be terminated and sealed properly.
- Pipe stand-off length shall allow for a minimum space of 50mm between the outside diameter of the insulated pipe and to a vessel shell or mechanical package,
- Length of insulated nozzles and man-ways shall be sufficiently sized to guarantee flange bolt withdrawal and to allow for the insulation and jacketing to be terminated and sealed independently of the nozzle flange insulation.

The design and installation of insulation systems shall be such that the risk of ingress of water into the insulation shall be reduced to a minimum, and at the same time allow for proper drainage. Metallic insulation stainless steel jackets are to be provided with drains to ensure that any moisture is removed. The SUPPLIER shall submit their metallic insulation jackets complete with drainage during detailed design.

For the purpose of inspecting pipes in service, removable sections of jacketing and insulation shall be provided. The design of these sections shall not compromise the continuity of the vapour barrier and weatherproofing generally in external applications.

Insulation and heat tracing of instrument pressure PT and LT connections where indicated on relevant P&IDs shall be provided and the extend of the insulation and heat tracing shall terminate at the PT and LT connections on the direct mounting before the pressure gauge.

Support rings for any vertical insulation shall be a bolted design and constructed in 316SS.

4.5 PIPING INSULATION

Insulation on long vertical pipe runs shall be supported with rings spaced on 3600mm maximum centres installed on the piping. Width of rings shall be half the thickness of the insulation material.

The rings shall be fastened to the piping.

4.6 REMOVABLE INSULATION OF FLANGES AND VALVES

4.6.1 General

Removable insulation for flanges and valves, such as non-metallic flexible insulating blankets/mattress shall be suitable for quick removal and reinstallation.

The cover shall be weather tight.

Non-metallic flexible insulating blankets/mattress shall fit the actual valve and flange and secure minimum 100mm overlap to incoming insulated pipe.

The non-metallic flexible insulating blankets/mattress shall have a design that allows frequent removal and reinstallation without causing damage and shall consist of one piece only where achievable. The valves' stem shall protrude through the blanket and shall be retained in position with 316SS springs, hooks, belts/buckles and velcro.

Flanges and valves shall be insulated for reasons of heat conservation and electrical tracing as stated in the P&IDs.

Non-metallic flexible insulating blankets/mattress shall be provided with drainage at its lowest point.

SUPPLIER shall detail their design for a non-metallic flexible insulating blankets/mattress including material to CONTRACTOR for review and approval during the technical evaluations.

4.6.2 Accessories

All metal accessories shall be of stainless steel (AISI 316). Galvanised steel strips, plates or wiring are not acceptable for insulation covering or fastening.

4.6.3 Identification

Each removable part of an insulation cover shall be provided with an identification plate with the following information.

- vendor name,
- line number,
- tag number,
- cover number,
- design requirement (insulation class, fire requirements etc.).

The identification number system shall be easily read prior to and after installation.

The SUPPLIER shall identify each cover on drawings and store this information as retain documentation.

The identification plate shall be made of a material resistant to water and applicable media typically 316SS.

4.6.4 Insulation of Instrument and Instrument tubing

For insulation of instruments and tubing shall be insulated with a suitable AF/ARMAFLEX system or similar, which shall provide identical thermal properties or better than rockwool.

Manufacturer of pre-insulated instrument tubes may be used pending approval by CONTRACTOR.

4.6.5 Metallic jacketing

Longitudinal seams of metal jackets on horizontal or sloping pipes shall be located maximum 60 degrees away from the lowest point of the circumference.

All seams on metallic jacketing shall be provided with a sealant in between the overlap.

Jacketing shall, as a general rule, be terminated with a fold and gasket to prevent water ingress and galvanic corrosion. The termination shall be secured with bands typically in 316SS. For removable insulation, the terminations shall be secured with toggle latches or band with toggle latches.

Sharp edges are not allowed.

For terminations where there are no risk of water ingress (e.g. on the underside of vertical installed valve), terminations without fold and gaskets are acceptable

4.6.6 Electrical Heat Tracing

Heat tracing elements shall be located in either the 4 or 8 o'clock positions.

Heat tracing elements' size should not exceed 7mm based on SUPPLIER's confirmation.

Where heat tracing is applied on systems aluminium foil min 0.045mm thick before mineral wool is applied over the heating cable to preliminary protect the heating cable and heat distribution.

The method of specifying 'the next NPS up' to accommodate the tracer shall be avoided since this will result in an excessive gap between the pipe wall and insulation which could then compromise system integrity.

Where heating cables penetrate the jacketing, edge protection shall be provided to prevent damage to the cable. A permanent sealer shall be applied in order to prevent ingress of water. For electrically traced lines identification plates min 316SS shall be provided.

Electrical Heat Tracing on CPVC shall be completed in conjunction with a CPVC SUPPLIER to ensure the cables are laid correctly over the CPVC to guarantee a uniform thermal temperature without damaging the CPVC system.

4.6.7 Drains

For all insulation systems there shall be minimum 10mm diameter drain holes in all low points and a minimum of one hole every 3m on horizontal runs. Drain holes shall penetrate the whole insulation system. Necessary precaution shall be taken to avoid damage to the surface protection on the piping and heat tracing cables.

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4.7 MATERIALS

4.7.1 General

Where proprietary trade names are used within this specification alternative manufacturers and equivalent materials can be used pending approval from CONTRACTOR.

All insulation materials shall have a neutral pH value.

The materials shall not release toxic (see IMO Resolution MSC. 41 (64)) or corrosive gases when exposed to fire. No asbestos or asbestos products shall be used. No lead or lead products shall be used unless accepted by CONTRACTOR.

4.7.2 Mineral wool

Mineral wool shall conform to EN 14303. Properties specified in Table 4-1 shall be declared.

EN14303	Property	Requirement
4.3.2	Maximum ST (+)	Shall always be declared
4.3.4	Water absorption, Wp	WS < 1,0 kg/m^2
4.3.6	Trace quantities of water soluble ions and the pH value	CL: To be declared pH: neutral
C.3	Airflow resistivity	To be declared, if necessary

Table 4-1 Mineral Wool properties

Declared thermal conductivity shall be equal to or better than given in Table 4-2.

Mean temp. °C	0	50	100	150	200	250	300	350
λD - W/mK	0,033	0,036	0,044	0,051	0,0161	0,073	0,067	0,103

Table 4-2 – Mineral wool pipe sections/slabs/pipe section mats/bevelled lags

Note - Type of wire netting shall be stainless steel.

4.7.3 Metallic foils and vapour barrier

Metallic foils used in connection with heat tracing shall be in accordance with Sect. 4.6.6.

An additional layer of 25mm mineral wool for protection of the vapour barrier shall be applied before installation of the metal jacketing for electrical heat tracing.

4.7.4 Metallic jacketing

Metallic jacketing shall be stainless steel in accordance with Sect. 4.6.5.

Stainless steel metal jacketing shall be type AISI 316, 2B finish.

Stainless steel sheets for pipes up to DN 450 shall have a minimum thickness of 0.5mm.

4.7.5 Perforated guards for Personnel Protection

Stainless steel perforated metal jacketing shall be of type AISI SS316, 2B finish, with minimum 0.9mm thickness, 5mm hole diameter and 8mm hole pitch.

Distance holders shall be made of polytetrafluorpethylene and may be used on pipes up to 101.6mm (4 in).

Minimum numbers of distance holders shall be three per circumferential location. For larger dimensions, corrugated stainless steel metal jacketing shall be used.

Distance holders shall be installed with maximum 300mm.

All personnel protection shall be easily removed by mechanical means. The standoff design, guard spacing from surface depending upon temperature and proposed form of personnel protection shall be provided by the SUPPLIER and reviewed and approved by CONTRACTOR.

For mechanical equipment, personnel protection shall also be provided as and when required. Suitable brackets on the external sections of vessels to permit personnel protection to be assembled shall be provided by the SUPPLIER. The bracket design and any welding, if applicable, to secure the bracket to the pressure vessel and any peripheral bracket fasteners, etc shall be reviewed and approved by CONTRACTOR.

4.8 INSULATION SYSTEMS SUMMARY

4.8.1 Heat Conservation

The purpose is to reduce heat losses and to maintain temperatures for the efficient operation of the process.

4.8.2 Electrical Heat Tracing

To guarantee a continual thermal temperature to the system for process conditions, electrical heat tracing shall be provided depending upon service as defined in Ref. [6] 123A90-DDL-PR-RE-80032.

The insulation systems and key data are stated below in Table 4-3.

Type	Material	Vapour Barrier	Jacketing	Flange/Valve insulation
Heat Conservation	Mineral Wool	-	316SS	non-metallic flexible insulating blankets/mattress

Electrical Tracing	Mineral Wool	Aluminium Foil	316SS	non-metallic flexible insulating blankets/mattress

Table 4-3 - Insulation systems key data

Note

1) Isolation for tubing and relevant instrumentation to be with AF/ARMAFLEX system or similar,
2) The mineral wool insulation thickness shall be calculated in accordance with EN ISO 12241 and based upon specific project requirements such as heat loss, energy input etc. SUPPLIER shall detail the calculated mineral wool thicknesses and present these values to CONTRACTOR during technical evaluations.

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