Base Load Power Hub (BLPH)

COMMISSIONING PROCEDURE - E&I SHELTERS

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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.

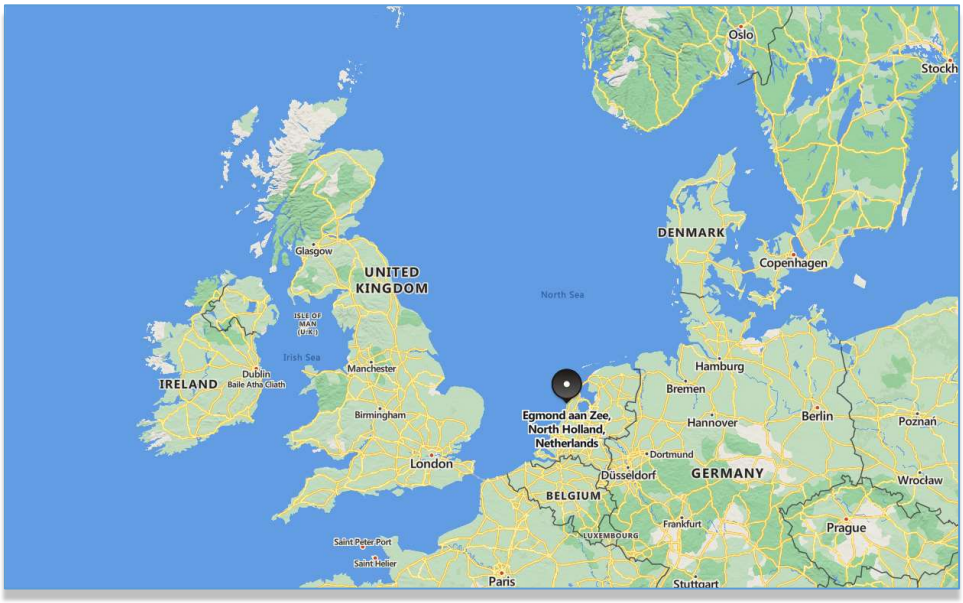


Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map

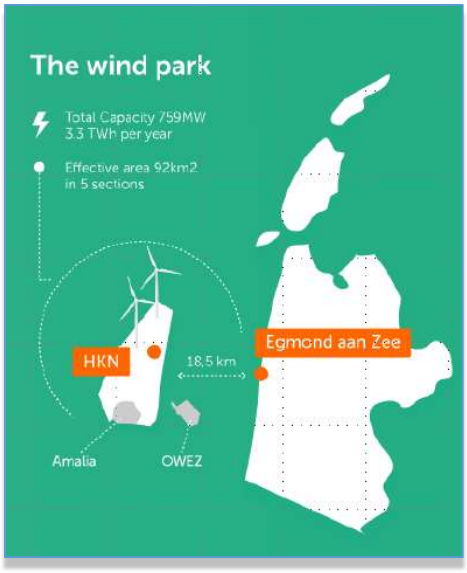


Figure 2 - Wind Park Details

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.

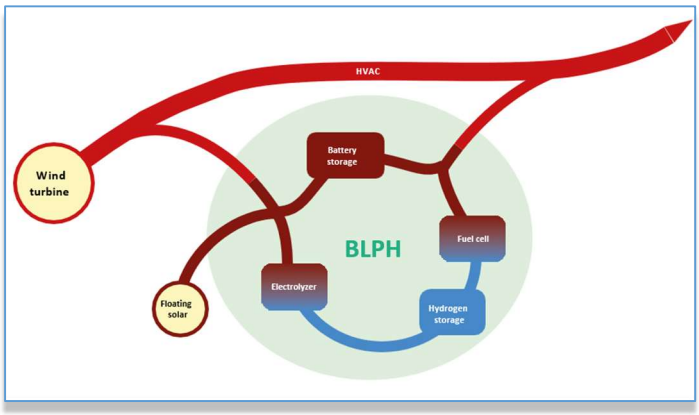


Figure 3 – BLPH Concept

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.

1.1.3 Plant and Equipment

- HV (66KV 6.6KV) SWITCH ROOM B-100
- LV (400V) SWITCH ROOM B-200
- AC UPS EQUIPMENT ROOM B-300
- I&T EQUIPMENT ROOM B-400

2 DOCUMENT SCOPE

The purpose of this document is to provide the operating methods for verifying the quality and design requirements relating to the shelter and in particular the HVAC system. The aim is to provide objective evidence that all engineering, design and specification requirements are correctly understood, verified and recorded.

2.1 REFERENCES

Doc. No.	Description
123A90-DDL-EL-DL-20104	Electrical Equipment Layout
123A90-DDL-EL-DL-20111	Electrical Cable Routing Layout
123A90-DDL-EL-DL-20122	Lighting & Socket Layout
123A90-DDL-EL-DG-20129	Lighting & Socket Circuit Diagr.
123A90-DDL-EL-DL-20136	Earthing & Lightning Layout
123A90-PML-QHSE-QP-00002	Project Quality Plan
1724000049-QC-PRO-00056	FAT Procedure
K559-2254-EL-PHI-002	Electrical System Description & Design Philosophy
K559-2254-IC-PHI-001	Control Systems Philosophy
K559-2254-PM-PHI-001	Equipment and System Tag Numbering
IEC 61439-1	Low-voltage switchgear and controlgear assemblies - Part 1: General rules
NFPA 90A	Standard for the Installation of Air-Conditioning and Ventilating Systems

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

Table 2 - Definitions and Abbreviations

Abbreviations	Description
AC	Voltage Alternating Current
Ah	Ampere-Hour
ATEX	Atmospheric EXplosible
CAT	Category
CENELEC	Committee for Electrotechnical
DC	Voltage Direct Current
EMT	Electrical Metallic Conduit
IEC	International Electrotechnical Commission
IEE	Institute of Electrical Engineers
IEEE	Institute of Electrical and Electronic Engineers
IP	Ingress Protection
IS	Intrinsically Safe
ISO	Internation Standard Organization
ITU	Internation Telecommunications Union
JB	Junction Box
MCT	Multi-Cable Transit
NC/NO	Normally Close / Normally Open
PCS	Passive Cooled Shelter
RTU	Remote Terminal Unit
TIA/EIA	Telecommunications Industry Association/Electronics Industries Association
W	Watts (in Power)

3 BUILDING RELATED CHECKS

INSPECTION TEST	B100	B200	B300	B400	Completed by Date	Witnessed by Date
VISUAL INSPECTION						
ELECTRICAL CHECKS						
HVAC TEST						
HVAC PRESSURIZATION AND TEMPERATURE TEST						

3.1 VISUAL INSPECTION

INSPECTION TEST	B100	B200	B300	B400	Completed by Date	Witnessed by Date
VISUAL INSPECTION						
DIMENSIONAL CHECKS						
PAINTING CHECK						
CHECK OF NAMEPLATES						
CHECK OF COMPONENTS TYPE AND POSITION						

- To ensure that all the necessary documentation is available.
- To verify that the Local Shelter building is delivered to site in good condition to ensure no damage resulting from shipment and with correct dimensions.
- Ensure that the filters installed on pressurization unit are clean. In case the pressurization unit is stored for long without protection, sand and dirt could be deposited on the filters. These must be replaced before starting the test.
- The result of inspection shall be documented in test data record of Annex 1

4 ELECTRICAL CHECKS AND PRE POWER-UP HVAC CHECKS BEFORE ENERGIZING

INSPECTION TEST	B100	B200	B300	B400	Completed by Date	Witnessed by Date
CHECK AND FUNCTIONAL TEST OF LIGHTING SYSTEM						
CHECK OF GROUNDING SYSTEM						
CHECK OF COMPONENTS TYPE AND POSITION						

- To ensure correct power, grounding and function of lighting and socket outlet.
- Ensure that all instruments and equipment are connected.
- Before powering on the HVAC system, all the power and signal electrical connections between Local Shelter and HVAC/Pressurization units need to carefully checked and verified against the drawings.
- Lighting system:
- Main characteristics of fixture and lighting material comply with project documentation.
- Correct installation of lighting fixture and completeness of lighting circuit
- Socket system:
- Main characteristics of power socket comply with project documentation.
- Correct installation of power socket and completeness of power distribution system.
- Earthing and lightning system:
- Main characteristics of earthing material comply with project documentation.
- Earthing system continuity checks.

- Building local board:
- Check of correct board installation
- Insulation test on equipment
- Electrical functionality check and test of auxiliary and accessories (switch, relay, alarms, signaling, interstrip, others)

- Checks and test after energizing:
- Preliminary check on external supply (Upstream switchgear, others)
- On voltage test and measurement (protection device, fixture, switch, sockets, illumination level, signaling and alarm.

5 HVAC TESTS SYSTEM INTEGRATION TEST PRE-REQUISITES:

Note: HVAC system can also be tested without the F&G system in operation. However, both the system is required to be working in order to perform the integration test.

- Verify that the extinguishing system is disabled.
- Make sure to have all MCTs completely sealed and all doors closed for the pressurization test and cooling performance test.
- Verify that all construction completion tests have been completed.
- Verify if the assembly completeness of each cabinet/console/equipment is compliant with the hardware configuration drawings provided by the vendor.
- Verify the functional and safety grounding networks outside the cabinets.
- Verify that the identification labels are properly located on the relevant cabinet/console/equipment.
- Verify the correctness of power supply connections (cables and terminals) according to Vendor/project documents.
- Verify electrical continuity between grounding bars of different cabinets.
- Power up of incoming lines (to each cabinet) and verify the relevant voltage level and polarity of power lines.
- Verify the hardware interconnections between systems.

6 HVAC SYSTEM PERFORMANCE TEST

6.1 VISUAL INSPECTION

The purpose of this part of test procedure is:

- To verify the HVAC capability to cool the air inside the Local Shelter.
- To test the pressurizing system to verify the over pressurization.

6.2 TEST STEPS

- Check temperature set point of each unit. Set point must be as per the specification:

Set point and temperature will be set considering site test environment and not following destination site requirements.

INSPECTION TEST	B100	B200	B300	B400	Completed by Date	Witnessed by Date
VISUAL & DIMENSIONAL CHECK OF THE HVAC						
CHECK OF GROUNDING SYSTEM						
FULL PANEL ELECTRICAL / CONTROL OPERATION & FUNCTION TEST						
DIELECTRIC TEST						
QUALITY AND QUANTITY CHECK FOR WEARABLE PART AND SPARE PARTS						
CHECKING OF PROTECTIVE MEASURES AND OF THE ELECTRICAL CONTINUITY OF THE PROTECTIVE CIRCUITS						

The following document refers to the details to be done in the Power and Control Cabinet :

1724000049-HV-DA-00026	**01**	**B-100 HVAC and LIGHTING PANEL WIRING DRAWINGS and GENERAL ARRANGEMENT (INCL INTERCONNECTING)**
1724000049-HV-DA-00027	**01**	**B-200 HVAC and LIGHTING PANEL WIRING DRAWINGS and GENERAL ARRANGEMENT (INCL INTERCONNECTING)**
1724000049-HV-DA-00028	**01**	**B-300 HVAC and LIGHTING PANEL WIRING DRAWINGS and GENERAL ARRANGEMENT (INCL INTERCONNECTING)**
1724000049-HV-DA-00029	**01**	**B-400 HVAC and LIGHTING PANEL WIRING DRAWINGS and GENERAL ARRANGEMENT (INCL INTERCONNECTING)**

- The setpoints can be modified however it is not recommended to do that.

- Check that, when the all selector is on position, fire damper and are opened.

Notes:

- In the absence of a dissipative or partial load inside the Shelter, the required thermal dissipation will be obtained, in accordance with what is qualified in the document Local Shelter HVAC Calculation Notes, by means of portable electrical heaters.

- Switch ON all internal equipment inside the Local Shelter with doors closed and measure the temperature after at least 1 hour.
- Switch on HVAC system and monitor the internal temperature. Once the set point is reached, monitor the temperature for one hour.
- During this test, a pressurization test will also be performed by pressure tools (not supplied) to verify an overpressure of greater than or equal 50 Pa .

6.3 ACCEPTANCE

- The HVAC system must maintain the temperature inside the Shelter Room with the doors closed during the hottest part of the day for one hour.

- Differential pressure is greater than or equal 50 Pa inside the building.

6.4 RESULTS TABLE

- The results of the measurement (temperature) shall be recorded on Test Data Record.
- The record of all temperature and their location shall be taken during the duration on precondition and the test performance on both HVAC units.
- Record the differential pressure.
- The results of this test shall be recorded on Test Data Record of Annex No 1

7 HVAC AIR CONDITIONING CONTROL UNIT TEST

7.1 TEST SCOPE

- The purpose of this test is to ensure the functionality of both HVAC units and their automatic operation, failure and auto changeover.

7.2 TEST STEPS

Inspection Results	Positive	Negative	Completed by Date	Witnessed by Date
End of connection				
Wiring hardness check				
Numeration of cable				
Grounding				
Main braker Supply Voltage check				
UPS Supply voltage check				
Close all switches and check supply of all the users				

7.3 ACCEPTANCE

Inspection Results	Positive	Negative	Completed by Date	Witnessed by Date
HMI panel and PID correspondence				
Unit exchange in case of fault of one unit				
Automatic and manual function				
Shutdown contact functional check				
Remote start/stop of HVAC system by ModBUs signal				
Major Fault in case of both unit fault and Overpressure Sensor Fault				
Low overpressure alarm				
Space heater Status and setpoint				
Electrical Heater protection thermostate				
Temperature sensor indication check				
Overpressure sensor check				

For B100 and B200

Inspection Results	Positive	Negative	Completed by Date	Witnessed by Date
Fire damper open and close contact HMI check				
Fire damper Faul				
Unit Dampers Visual position on HMI				
Fresh air electrical heater functional check				
Fresh air filter clogged signal				
Overpressure maintenance				
Fan running feedback on HMI				
Alarm on HMI				

For B300 and B400

Inspection Results	Positive	Negative	Completed by Date	Witnessed by Date
Fire damper open and close contact HMI check				
Fire damper Faul				
Units Dampers Visual position on HMI				
Fresh air electrical heater functional check				
Fresh air filter clogged signal				
Overpressure maintenance				
Fan running feedback on HMI				
Alarm on HMI				
Cooling start and setpoint				

7.4 MEASUREMENT EQUIPMENT

Inspection Results	Positive	Negative	Completed by Date	Witnessed by Date
Unit exchange in case of fault				
HMI correct visualization				
Maintenance of overpressure				
Shutdown correct response				
Lighting and socket functionality				
Heater setpoint reach				
Major fault contact				
Cooling performance reached (Only for B300 and B400)				

7.5 RESULTS TABLE

- The results of this test shall be recorded on Test Data Record of Annex 1.

ANNEX 1

COMMISSIONING TEST RECORD

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1. HVAC AND PRESSURIZATION SYSTEM PERFORMANCE AND FUNCTIONAL TEST

Customer Name: Rosetti Marino **Customer Reference:** **Project Name:** BASE LOAD POWER HUB (BLPH) **Reference Doc Number:** CW-I-WP4-2023-05	**Verification** **RM** By: Date:

No.	Test #	Detail Test Item	OK	NOK	RTST OK
1		**Temperature test- HVAC system**			
	1.1	**Test Requirements:** Close the door of the shelter and power up equipment inside the Local Shelter. Record the internal temperature just before switching on HVAC. Monitor the temperature and record the time taken for HVAC to bring down the temperature from the initial temperature to the setpoint. Monitor internal temperature status for 1 hour. **Measurement Equipment:** Meter or equivalent and Multifunction Meter Testo. **Note the reading here:** Temperature before the test:_____time : _____ Temp reached setpoint : _____time:____ **Acceptance (Pass/Fail Criteria):** system maintained			
2		**HVAC Air Conditioning Control Unit (ACCU) Functional Test**			
	2.1	**Test Requirements:** Perform the test by keeping the breakers in ON position and Perform the test keeping the switches in the ON position and create a major fault on hvac/pu. running and waiting for the exchange Within 2 minutes check that the second HVAC unit starts automatically. The tests shall be performed on each HVAC unit. **Acceptance (Pass/Fail Criteria):** Within 2 minutes the standby HVAC unit will start automatically.			

3		**Pressurization System**			
	3.1	**Test Requirements:** Ensure that the filters installed on pressurization unit are clean. **Acceptance (Pass/Fail Criteria):** The filters installed on pressurization unit are clean			
	3.2	**Test Requirements:** Measure the differential pressure using pressure tools (not supplied) to verify an overpressure. **Note the reading here:** Before the test: _____ During the test: _____ **Acceptance (Pass/Fail Criteria):** The system maintains a positive pressure within the Local shelter with the door(s) closed (>/= 50 Pa).			