Base Load Power Hub (BLPH)

NITROGEN GENERATION PACKAGE
FAT (FACTORY ACCEPTANCE TEST) PROCEDURE

Document Number: 1724000437-QC-PRO-00023

Document Class: 2

03	23/12/2024	Accepted for Construction (AFC)	GT	MC	TM
02	02/10/2024	Issue for Review (IFR)	GT	MC	TM
01	07/09/2024	Issue for Review (IFR)	GT	MC	TM
00	19/04/2024	Issue for Review (IFR)	GT	MC	TM
Rev.	Date	Description	Prepared	Reviewed	Approved

COES

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Revision / Change Log

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

HOLDS LIST

No.	Description
1	
2	
3	
4	

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Lifting sketch

None

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.

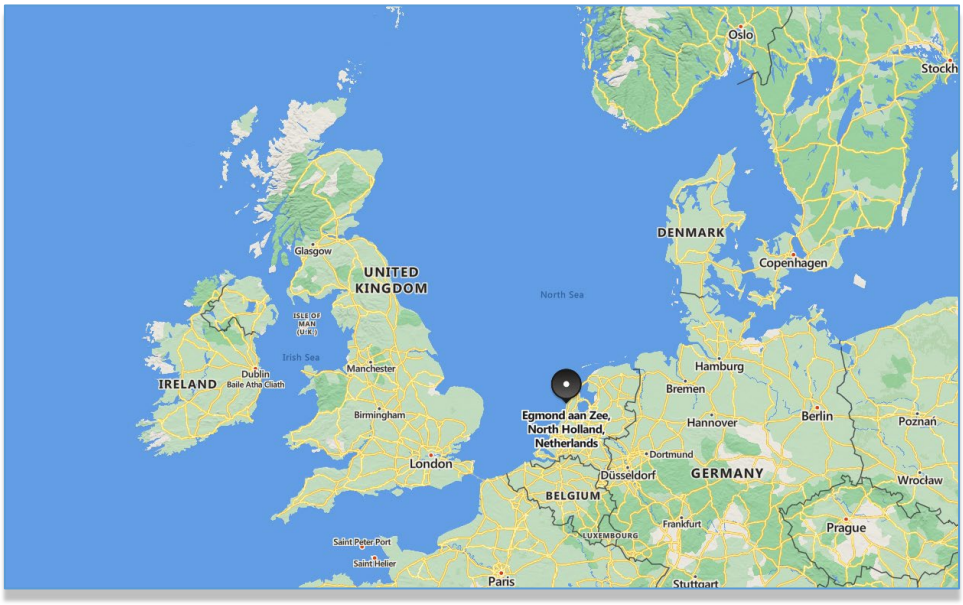


Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map

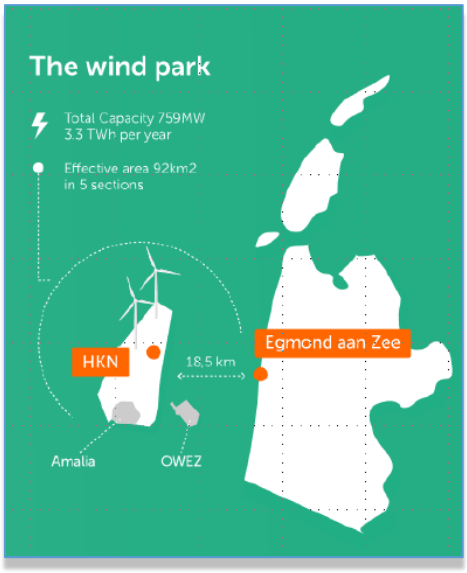


Figure 2 - Wind Park Details

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.

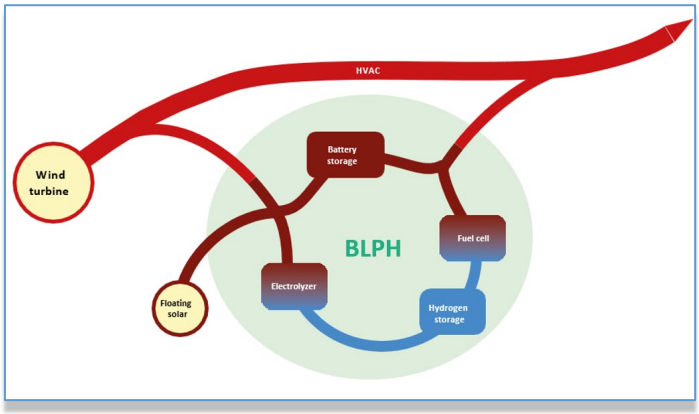


Figure 3 – BLPH Concept

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

This document identifies any electrical equipment to be fed with its main characteristics.

2.1 REFERENCES

Doc. No.	Description
1724000437-PR-PID-00018	PACKAGE P&ID
1724000437-MAC-DA-00005	CERTIFIED PACKAGE GENERAL ARRANGEMENT AND DIMENSIONAL OUTLINE DRAWINGS (INCLUDING : NAMEPLATE, BASEFRAME, FOUNDATION LOADS, NOZZLES LOADS, NOZZLES LIST, BATTERY LIMITS, CoG)
1724000437-QC-ITP-00002	INSPECTION TEST PLAN (ITP)
1724000437-MAC-SP-00003	SYSTEM/PACKAGE FUNCTIONAL DESCRIPTION
1724000437-MAC-DG-00009	PACKAGE WIRING DIAGRAM INCLUDING LAYOUT OF PACKAGE CONTROL PANEL
1724000437-MAC-DS-00011	EQUIPMENT DATA SHEETS
1724000437-MAT-PRO-00021	PAINTING PROCEDURE

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

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3 FAT PROCEDURE

3.1 VISUAL AND DIMENSIONAL CHECK

3.1.1 SCOPE

This procedure has the scope of giving instructions to Coes personnel for the performance of visual and dimensional control on complete nitrogen generation package.

3.1.2 RESPONSIBILITY

The QCI shall proceed to the performance of the test with his personnel following the instructions of QCM who has the responsibility of the enforcement of this procedure.

3.1.3 EXAMINATION

A bend meter is used for the dimensional inspection so that to verify that overall sizes of the generator correspond to figures shown on general arrangement drawing.

During this check, the location and the dimensions of the group limits as well as the total height of the generator will be verified.

The inspection will give a satisfactory result only if sizes will be in accordance with those shown on general arrangement drawing: acceptable tolerance is ± 10 mm on the battery limits.

At least the following shall be checked:

- Foundation and/or fixation position check
- Tank drain position check (if applicable)
- Earthing position check
- Location of the terminal box
- All terminal points
- Visual check of flange surface condition at terminal points
- Electrical earthing continuity check (max 1Ω)
- Pipe routing and all the equipment connections and installations shall be in compliance with P&ID and GAD
- Instrument connection as per approved hook-ups

Test certificates shall be provided at the end of satisfactory test

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3.2 LOCAL PANEL WIRING CHECK

3.2.1 SCOPE

This procedure has the scope of giving instructions to Coes personnel for the performance of wiring check on local panels installed on nitrogen generator package.

3.2.2 RESPONSIBILITY

The QCI shall proceed to the performance of the test with his personnel following the instructions of the QCM who has the responsibility of the enforcement of this procedure.

3.2.3 EXAMINATION

Local control panel, junction boxes (if any) and instruments are checked according to the reference documents.

The test will give a satisfactory result only if wiring has been executed according to the reference drawings.

All I/O signals shall be validated.

A functional test of the Control/Safety Logics managed by Local Control Panel shall be executed.

The interface (hardwired and Serial) between Local Control Panel and Contractor's Control and Safety system, shall be checked.

Test certificates shall be provided at the end of satisfactory test

3.3 MARKING AND NAMEPLATES CHECK

3.3.1 SCOPE

This procedure has the scope of giving instructions to Coes personnel for the performance of the nameplates check on complete nitrogen generator package.

3.3.2 RESPONSIBILITY

The QCI shall proceed to the performance of the test with his personnel following the instructions of the QCM who has the responsibility of the enforcement of this procedure.

3.3.3 EXAMINATION

Components tagging is checked according to P&ID: if customer does not assign dedicated items to all the components, Coes indicates standard items on P&ID, but tagging is not carried out.

Pressure vessel nameplates are checked according to construction drawings.

The inspection will give a satisfactory result only if all components are correctly tagged and all pressure vessels are correctly marked.

Test certificates shall be provided at the end of satisfactory test

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3.4 PNEUMATIC LEAKAGE TEST

3.4.1 SCOPE

This procedure has the scope of giving instructions to Coes personnel for the performance of leakage test on complete nitrogen generator package.

3.4.2 RESPONSIBILITY

The QCI shall prepare the item for the leakage test and proceed to the performance of the test with his personnel following the instructions of the QCM who has the responsibility of the enforcement of this procedure.

3.4.3 TEST

During this test the nitrogen generator package is pressurized up to 7 barg and isolated to check that no leakage occurs.

During this test all valves installed in nitrogen generation package shall be in open position.

After 1 hour it is verified if the pressure is mainteined.

Then the pressure is reduced to 1 barg and the perfect sealing of all flanged and threaded connections is verified, using soapy water: the test will give a satisfactory result only if air pockets will not be noticed.

In case air pockets are detected, connection must be tighten and leakage test has to be repeated until it gives a satisfactory result.

Instruments used to perform the test shall have valid calibration certificates to be attached to test report.

The instruments used are the ones installed on the package according to reference P&ID, document no. 1724000437-PR-PID-00018.

Test certificates shall be provided at the end of satisfactory test

3.5 FAT PERFORMANCE TEST

3.5.1 SCOPE

This procedure has the scope of giving instructions to Coes personnel for the performance of functional test on complete nitrogen generator package.

3.5.2 RESPONSIBILITY

The QCI shall prepare the item for the test and proceed to the performance of the test with his personnel following the instructions of the QCM who has the responsibility of the enforcement of this procedure.

3.5.3 TEST

During this test, at least no.2 complete operating cycles will be simulated, to verify the full functionality of the package, the good operation of all installed components and the proper sequence of all the different phases, as described in the functional description.

The test is carried out using Instrument air package, connected to the N2 package by means of flexible hoses.

The test will give a satisfactory result only if the different phases of the operating cycle will take place correctly, as described in the functional description.

The following measured values will be checked:

- Check PSA adsorption/regeneration operating pressure by means of pressure gauges 64-PI-054 / 64-PI-055.
- Check after-filter pressure drop by means of differential pressure transmitter 64-PDIT-056.

Performance guarantees:

- Outlet N2 purity, by means of analyzer 64-AT-051 installed downstream PSA: 97%
- Outlet N2 package flowrate, by means of a flow indicator (shop test instrument) installed at the N2 package outlet: 60 Nm3/h (design conditions)
- Outlet N2 package pressure, by means of pressure transmitter 64-PIT-057: 8.1 barg

Performances of the N2 package are guaranteed if the above mentioned parameters are detected stable for 30 minutes minumum.

Instruments used to perform the test shall have valid calibration certificates to be attached to test report.

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Functional test of all the installed transmitters wired from the local control panel to be considered during the functional test.

A functional test of the Control/Safety Logics managed by Local Control Panel shall be executed.

The interface (hardwired and Serial) between Local Control Panel and Contractor's Control and Safety system, shall be checked.

Test certificates shall be provided at the end of satisfactory test

3.6 PAINTING CHECK

3.6.1 SCOPE

This procedure has the scope of giving instructions to Coes personnel for the performance of painting check on complete nitrogen generator package.

3.6.2 RESPONSIBILITY

The QCI shall proceed to the performance of the test with his personnel following the instructions of the QCM who has the responsibility of the enforcement of this procedure.

3.6.3 TEST

Total dry film thickness shall be measured using a magnetic induction instrument.

The test will give a satisfactory result only if:

- no points with film thickness less than 80% of the specified minimum thickness are found

- not more than 20% of thickness measurements taken at random shall be less than the specified minimum thickness

- RAL/color check to be performed (if applicable according painting procedure).

Instruments used to perform the test (magnetic induction instrument) shall have valid calibration certificates and shall be attached to FAT report

Test certificates shall be provided at the end of satisfactory test

3.7 LEGEND

QCI: quality control inspector

QCM: quality control manager

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