Base Load Power Hub (BLPH)

HYDROSTATIC TEST PROCEDURES – HYDROGEN VENT Q-43004

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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.

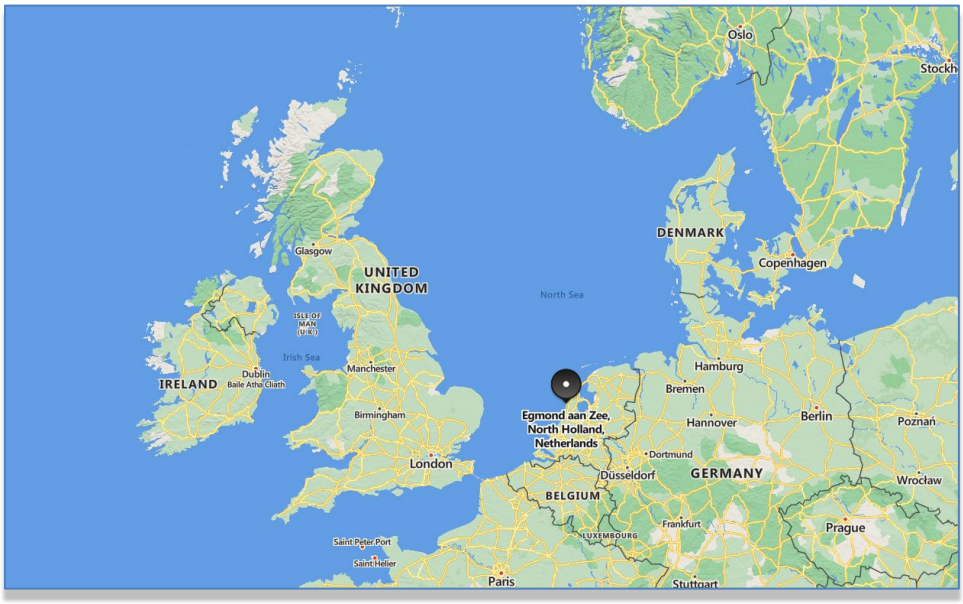


Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map

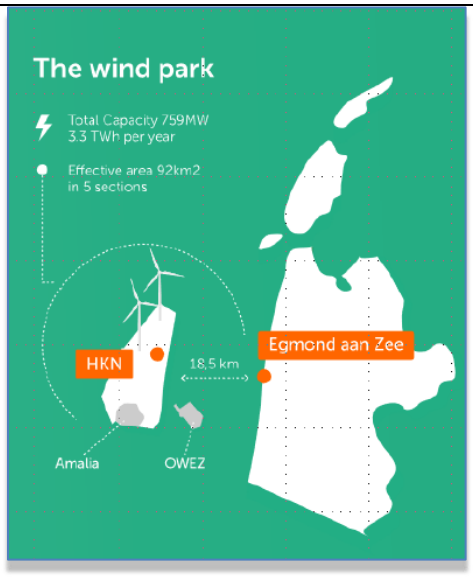


Figure 2 - Wind Park Details

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.

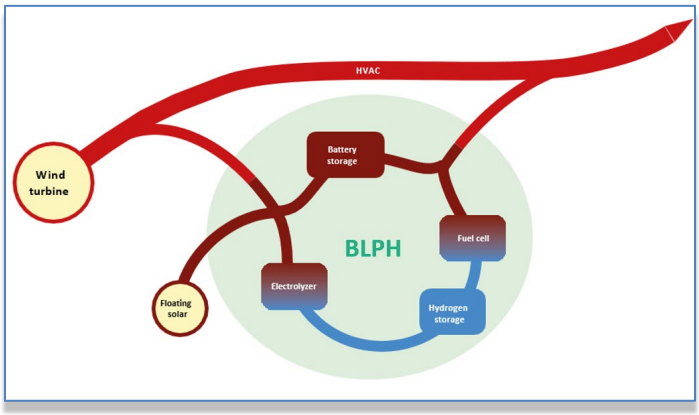


Figure 3 - BLPH Concept

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.

2.DOCUMENT SCOPE

This procedure aims to provide instructions for the correct execution and evaluation of the HYDROSTATIC PRESSURE TEST to carry out on the Hydrogen Vent

2.1 REFERENCES

The following procedure is in accordance with the codes below:

Dir 2014/68 EU All.1 par. 7.4

Consequently, it is applicable to devices designed and manufactured in accordance with such codes and rules.

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 1 - Definitions and Abbreviations

3. HYDROSTATIC TEST PROCEDURE

3.1 The Quality Control Supervisor will oversee the HYDROSTATIC PRESSURE (STATIC) TEST and issue the related inspection report

3.2 Water must be used for the test. When hydro-stating stainless steel vessel, or stainless-steel cladded vessel, water with chloride content lower than 50 ppm is to be used.

3.3 Test start is effective when water in the system is considered stabilized (deaerated, clean, properly tightened, etc.).

3.4 Test pressure must be measured with calibrated manometer

3.5 The manometer to be used must be among those catalogued in the instrument registry, and they must fulfil the requirements for the service requested. In addition, the calibration and control validity terms must not have expired.

3.6 If it is not easily visible, an additional manometer must be mounted in a more accessible and visible position for the duration of the test.

3.7 The manometer used must have a scale in the range of 1.5 times (minimum) and 4 times (maximum) the test pressure.

3.8 During the HYDROSTATIC PRESSURE TEST, the water temperature must not be less than 5°C and not more than 40°C.

3.9 Before bringing the device to the test pressure, it is necessary to isolate or dismantle all the devices that must not undergo increases in pressure and isolate areas or sections of the devices that are not subject to pneumatic verification.

3.10 The test pressure must be maintained for one hour at least, in the presence of the inspector, so to analyze the status of the entire device and detect possible losses.

3.11 The pressure should be raised gradually and under control

3.12 No pressure drops shall be observed during the test duration to consider it valid and completed.

3.13 After the HYDROSTATIC PRESSURE TEST, the piping spools must be brought back to its initial conditions.

3.14 The HYDROSTATIC PRESSURE TEST must be performed before any surface treatment and before any functional tests.

3.15 After completion of fabrication and testing, the equipment shall be thoroughly drained of water, dried and cleaned thoroughly of all grease, loose scale, rust flux, welds spatter and so on

4. HYDROSTATIC TEST PRESSURE

According to the Dir 2014/68 EU All.1 par. 7.4, the pressure for the TEST should be:
Pressure per PED = max (1.43*DP, 1.25*DP*ratio)
Pressure per the PED:
= max(1.43 * Design Pressure, 1.25 * Design Pressure * Stress ratio)
= max(1.43 * 350, 1.25 * 350 * 1)
= max(500.5, 437.5)
= 500.500 Kpa = 5.5Barg

5. ACCEPTABILITY CRITERIA

Hydraulic test is considered passed if the following is not revealed:
-indications of ruptures
-leakages, liquid drops and sweating in welds and in base metal
-pressure decrease as judged by a pressure gauge
-visible residual deformations
-leaks in flanged connections.

6. CORRECTIVE ACTION

6.1 Substitute the gaskets and re-establish the connections
6.2 Welding repair as agreed between the parties according to a specific procedure to be submitted if necessary

7. CERTIFICATION

HYDROSTATIC PRESSURE TEST completion certificates indicating the characteristics and results of the test will be drafted and issued by the Quality Control Department.
The certificate must be countersigned by the Quality Control Supervisor of the sub-supplier and by the inspector of the Client, if present at the test. Hydrostatic test report attached as sample.
The Authorized Inspector from Notified Body will witness the hydrostatic test.

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HYDROSTATIC PRESSURE TEST		
ENCORE THERMOENGINEERING S.r.l. ***MILANO - ITALY***	**HYDROSTATIC TEST REPORT**	**N° _____**
Item description :		
		Unit
Reference Drawing N°		
Test procedure N°		
Pressure gauge serial N°		
Pressure gauge rate		**Barg**
Test medium		
Design pressure		**Barg**
Design temperature		**°C**
Test pressure		**Barg**
Pressurization system		
Test temperature		**°C**
Holding time		**h**
Visual exam. under pressure		
Test result		
Notes :		
Inspector Signature	**Party stamp**	**Date**