Base Load Power Hub (BLPH)

Instrumentation Tubing Cleaning & Testing Procedure

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TABLE OF CONTENTS

1. PROJECT OUTLINE DESCRIPTION 4

1.1 PROJECT LOCATION 4

1.2 PROJECT CONCEPT 5

2. SCOPE 6

3. TERMS & DEFINITIONS 6

4. REFERENCE DOCUMENTS 7

4.1 INTERNATIONAL CODES / NORMS / STANDARDS 7

5. OFFSHORE TUBING AND FITTINGS 7

6. MARKING AND IDENTIFICATION 8

7. TUBING AND ACCESSORIES INSTALLATION 8

8. INSPECTION AND TEST 8

8.1 LINE CLEANING 9

8.2 PREPARATION AND TEST FOR INSTRUMENT IMPULSE AND PNEUMATIC LINES 9

9. SAFETY 10

10. RESPONSIBILITIES 10

11. ANNEXES 11

1. PROJECT OUTLINE DESCRIPTION

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 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.

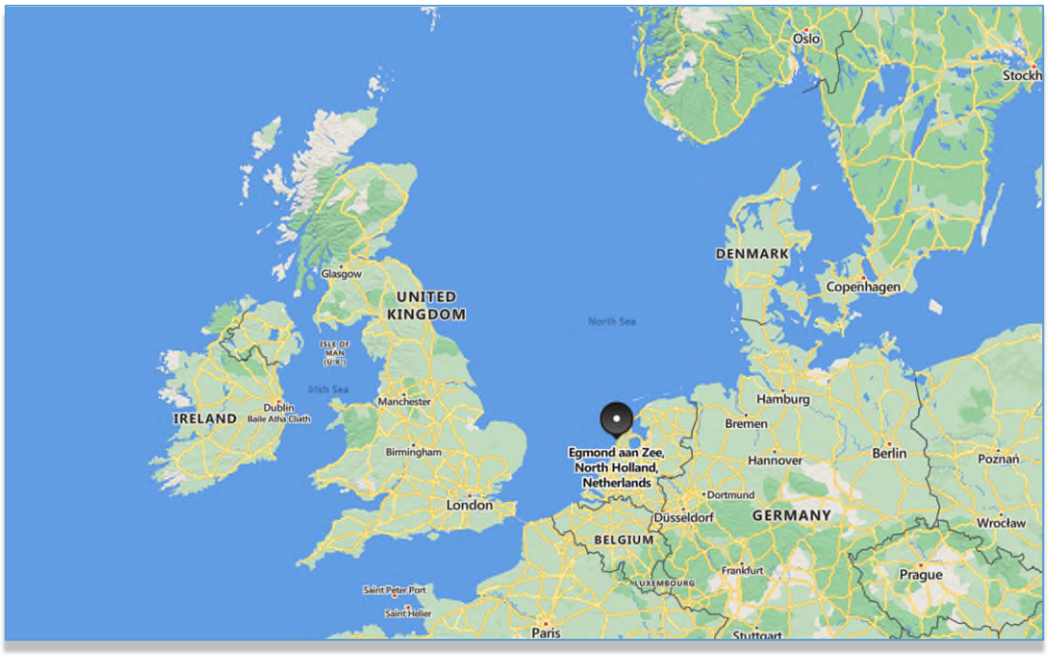


Figure 1 *- HOLLANDSE KUST NOORD WIND PARK Location Map*

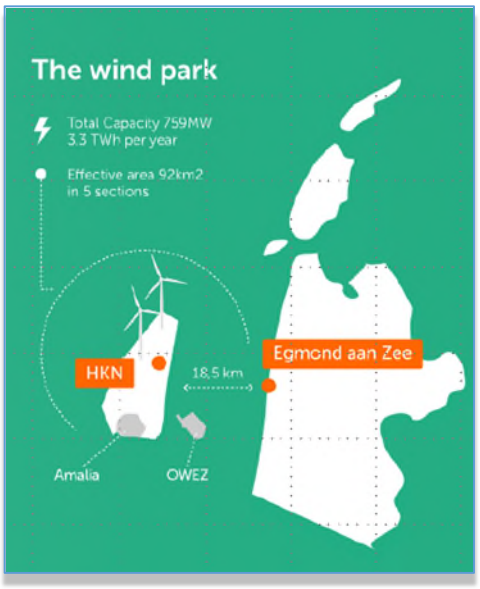


Figure 2 *- Wind Park Details*

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 is located on coordinates E 590719.1, N 5841602.3 and 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.

1.2 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.

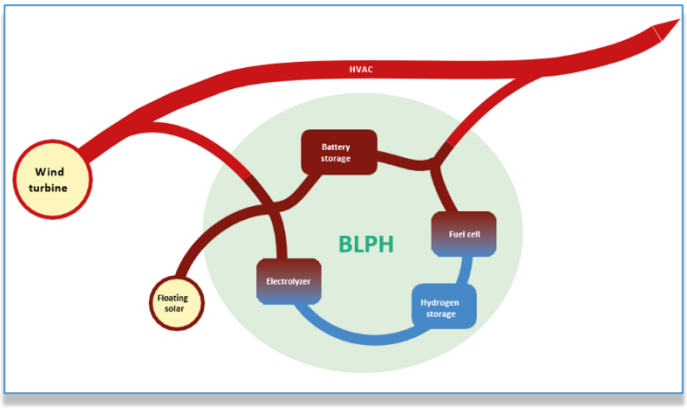


Figure 3 *– BLPH Concept*

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 is 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. SCOPE

Scope of this specification is to provide the general requirements and technical prescriptions covering execution and testing for the installation of instrument tubing to be provided for the BLPH Project.
Applicable International Standards and Codes shall be considered as an integral part of this specification.
The erection works shall be performed according to good engineering practice.

3. TERMS & DEFINITIONS

Terms and definitions enlisted hereunder may be applied and used in this document:

Terms	Definitions
COMPANY (CPY)	Means CROSSWIND C.V., owner & developer of the offshore WIND FARM Hollandse Kust Noord Wind Park Project.
CONTRACTOR (CTR)	Means ROSETTI MARINO S.p.A., the named party with whom COMPANY will place a contract for engineering, procurement, construction, offshore installation & Commissioning of the facilities associated with the PROJECT.
PROJECT	Refers to the BASE LOAD POWER HUB (BLPH) project.
Inspection and Test Plan (ITP)	Document that identifies the activities to be inspected as well as specifications, methods and acceptance criteria for monitoring and/or testing. It is a synonymous of "Quality Control Plan" (QCP)

4. REFERENCE DOCUMENTS

123A90-PML-PM-LIS-01001	Master Document Register
123A90-PML-COM-PRO-03007	Commissioning Strategy
123A90-PML-COM-PL-03002	Mechanical Completion & Commissioning Execution Plan
123A90-PML-QHSE-SP-00118	Mechanical Completion ITR Template Collection
123A90-PML-COM-LIS-03011	System/Sub-Systems List
123A90-PML-COM-LIS-03012	System/Sub-System Boundary Limit Diagrams
123A90-PML-QHSE-PRO-00120	PROVERLIS Management Procedure
123A90-PML-QHSE-PRO-00117	Punch list Management Procedure
123A90-PML-QHSE-RE-00115	Mechanical Completion Final Dossier
123A90-PML-QHSE-PRO-00107	Final Dossier Procedure
123A90-DDL-IN-LIS-40092	Instrument Tubing List

4.1 INTERNATIONAL CODES / NORMS / STANDARDS

ASME B16.11	Forged Fittings, Socket-Welding and Threaded
ASTM A1016/A1016M	Standard Specification For General Requirements For Ferritic Alloy Steel, Austenitic Alloy Steel, And Stainless Steel Tubes
ASTM A269	Standard Specification For Seamless And Welded Austenitic Stainless Steel Tubing For General Service
ISO 9095	Steel Tubes - Continuous Character Marking and Colour Coding for Material Identification *Note: Obsolete norm, not replaced by new revision or other document. To be used only as guideline*
NACE MR0175/ISO 15156	NACE International Standard - General principles for selection of cracking-resistant materials / Cracking-resistant carbon and low alloy steels / Cracking-resistant CRAs (corrosion-resistant alloys) and other alloys
AS4059E / ISO 4406	Cleanliness Classification for Hydraulic Fluids

5. OFFSHORE TUBING AND FITTINGS

Offshore (marine environment) instrument tubing shall be made of AISI 316L.

All tubing shall be seamless, fully annealed, complying with ASTM A269 and ASTM A1016/A1016M, free of scratches and suitable for bending and flaring.
Tubing sizes and wall thickness shall be determined based on suitable allowable working pressures, derived from material stress values as specified by ASME B31.3, including the de-rating factor for elevated temperature. The minimum wall thickness shall be 0.049 inch (1.125 mm).
The number of different tubing sizes used on a single site shall be minimised.

Instrument tube fittings shall be standardised to AISI F 316 stainless steel grade. When AISI 316L tubing is used then fittings shall be AISI 316L. AISI F 316 shall comply with ASTM A182/A182M.
All instrument tube fittings shall be double-ferrule compression type (except for HP applications).

Only one manufacturer shall be utilised on the plant, including package units. Particular care shall be taken when long lead items are procured to ensure standardisation of fitting manufacturer.
Consideration shall be taken of any existing model already used on site.
Tube fittings back ferrule shall be hardened and corrosion resistant and ASTM G48 or ASTM A262 tests documented by supplier.
Each component of the fitting shall be marked with traceable heat code.
The hardness of the fitting shall be greater than that of the tubing. A table shall be prepared by the supplier to show the hardness compatibility between tubing and fitting.
All threaded connections will be of NPT type as per ASME B16.11.
It is forbidden to mix tube fitting components from different manufacturers.

6. MARKING AND IDENTIFICATION

Each length of tubing shall be legibly marked in compliance with ISO 9095 and ASTM A1016/A1016M. The marking shall cover the whole length of the tube repeated without spaces).
Each tubing line shall be identified anchoring a metal tag plate. Identification shall be done as per example (see annex A).

7. TUBING AND ACCESSORIES INSTALLATION

All tubing shall be neatly laid out and adequately supported to prevent tube kink and facilitate trouble-shooting. Tubing shall not be left with any stress imposed.
The number of joints shall be kept to the minimum. Fittings on grouped tubing runs shall be staggered and off-set for easier accessibility.
All tubing shall be routed to provide maximum accessibility to all equipment. No tubing shall pass a control component in such a way that would prevent convenient calibration or adjustment or easy removal of the control component.
Tubing and electrical cables shall be run separately.
All piping connections to instruments shall avoid imposing stresses on the instrument.
Tubing clamps shall be made from non-conducting material in order to isolate the tube from the supports. All tube fitting construction materials shall be compatible with the tubing material selected.
Cutting shall be carried out using tube cutter (mechanical means) to achieve accurate 90°angle cuts. Flame cutters shall not be used. Wherever practical, bends shall be used instead of fittings. Bending shall be done with a tube bending machine.
The minimum-bending radius for installation shall be advised by tubing Supplier.
All personnel used for make-off of tube fittings shall have undergone training by the tube fitting supplier in the specific requirements of installing a fitting; Evidence of this training shall be provided to Company.
All pneumatic tubing shall be tagged at both ends: each side of penetrations, and every 25 meters.

8. INSPECTION AND TEST

The following minimum analysis and testing shall be performed for tubing and results of such shall be duly recorded, signed and dated (Form code CJX06, Annex B).

8.1 LINE CLEANING

Any test shall include a preliminary dry air cleaning of the small bore piping after fabrication to be performed internally, in order to remove all loose scale, weld spatter, sand and other foreign material. No pigs will be used.

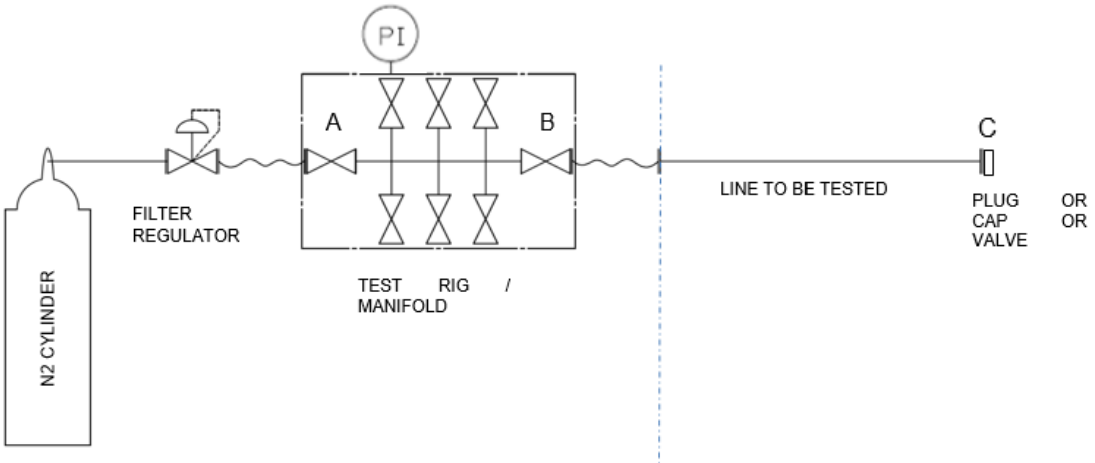
8.2 PREPARATION AND TEST FOR INSTRUMENT IMPULSE AND PNEUMATIC LINES

All tubing lines will be submitted to test with N_2 or dry air at a pressure equal or up to 1.1 normal working pressure. Pressure will be checked on pressure recorded and must remain constant at least 10 minutes (1 minute sampling).

The testing pressure will be performed as follow below:

The system or item to be tested shall be clearly identified on colour marked P&ID:

- Check that all equipment is rated for the test involved
- Disconnect the line to be tested at both ends and connect to the RIG or Manifold and tight the Cap or Valve “C” (if it’s a valve let it close)
- Close valve “A” and valve “B”
- Open N2 cylinder
- Set up the filter regulator at test pressure
- Slowly open valve “A” (keeping valve “B” closed) to let the pressure in (during this operation check the Pressure Indicator “PI”)
- Pressurize the circuit until the test pressure value is reached, by means of compressed dry air or N_2
- Slowly open valve “B” to make the pressure goes inside the line to be tested
- When pressure stabilize close the “A” valve
- Start test recording (PI)
- If no relevant leaks to be fixed, do a bubble test checking all the fittings
- After minimum 10 minutes without leaks test is done
- Depressurize the circuit by the meaning of a vent valve on the RIG or Manifold
- Stop test recording (PI)
- Close N2 cylinder and vent upstream trapped pressure
- Disconnect and reinstate the line



Acceptance Criteria

- Visual checks to confirm that system is free from leaks, clean and dry
- All measuring devices demonstrate that they are performing to required level of accuracy
- Internal pressure remains constant, except for minor fluctuations that shall be demonstrated to be related only to temperature variations
- A pressure drop may be accepted only if it's satisfactorily demonstrated to be exclusively due to temperature variations
- No leaks are found

9. SAFETY

A work permit shall be issued prior to commencement of test operations.
Pressure test heads must be taken into account.
Prior to commence the test the accesses required to inspect the tested system shall be arranged and authorized.
Scaffolds shall be erected as per procedure.
Ensure that area involved in testing is barricaded at safe distance from tested line during test period; all persons involved must stay away from the tested line.
The distance of the barriers from the pressure source is to be decided at Job safety Analyse/risk assessment submitted prior to the issue of the permit.
Additional shielding will be arranged where ejection of fragments is likely in case blow off (e.g. Bolted flanges, nipples, gauges etc.).
Ensure appropriate PPE to personnel involved in testing.
Verify that necessary tools safety whipped check was in place in each hose connection and fittings.
During the pipe and all welds and flanges connections are accessible for visual inspection only; no operation (e.g. Screwing bolts) on the tested system are allowed. Eye protection must be worn whilst on the worksite and must be worn during all torque tightening operations.

10. RESPONSIBILITIES

QC INSPECTOR: During the Mechanical Completion activities, QC Inspector will fill up the test sheets (Form code CJX06, Annex B) and, in agreement with the CPY, if there is any pending activity, he will then raise a new dedicated punch item.
These punch items will be imported into PROVERLIS.

MECHANICAL COMPLETION MANAGER: Manages the Mechanical Completion priorities according to the instructions provided and defined by the Commissioning team.

PROJECT QUALITY MANAGER: With the support of the Project QC Coordinator and the discipline specialists, coordinate the Inspection and Testing activities, assuring the issuance and the implementation of the Inspection and Test Plan; works as an interface with external Quality Inspectors (Client and Certification Institutions) for all inspections and quality control activities.

11. ANNEXES

- ANNEX A

TUBING MARKING EXAMPLE



- ANNEX B

TEMPLATE ITR CJX06

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ITEM	Tag		:				Dwg		
	S/Sys		:				Module		
TASK	code				Location			User	
FORM	Process	MC	Activity	CCK	Discipline	Instrumental	Form	CJX06	Tubing Hydraulic

	General
1	Drawings (P&ID tube) attached.
2	Isometric drawings (P&ID pipe) attached.
3	Check drawings at last revision.
4	Material certificates for pipe/tube/fittings/flanges/hose and support clamps checked
5	Welders certificates checked
6	Certificate and mark-up drawings for welding WPS and WPQR and material certificates checked
7	Certificates and mark-up drawings for NDT report checked
	Check before Flushing and/or Testing
8	Installation complete and in compliance with drawings and specifications.
9	Tubing/Piping tray checked.
10	Hose according to specifications and tightened
11	Flanges - nuts and bolts tightened.
12	Fittings are mounted and tightened.
13	Pipe supports completed and installed as required.
14	Cable ladders, trays, sharp edges protected, cut ends sealed.
15	Maintenance evaluation.

Page 1/2

REFER TO FINAL SHEET FOR ACCEPTANCE

ROSETTI MARINO CROSSWIND

ITEM	Tag	:		Dwg			
	S/Sys	:		Module			
TASK	code		Location		User		
FORM	Process MC	Activity CCK	Discipline Instrumental	Form CJX06		Tubing Hydraulic	

Flushing / Pressure testing

16 Drawings of flushing loops (P&ID tube) attached

17 Equipment & valves bypassed and blinded

18 Calibration certificates attached

19 Type of flushing medium correct

20 Printout from recorder/particle counter

21 Printout from pressure indicator

Final Check

22 Final inspection of pipework.

23 Preservation of tested pipework.

24 System/equipment labelled with: "Hot Oil flushing performed".

25 If required produce Red Line Mark Up for "AS BUILT"

TEST SPECIFIED USED

TEST FLUID: TEST PRESSURE BAR G: TEST DURATION :

TEST EQUIPMENT: SERIAL N°:

HOOK UP DIAGRAM Number:

Line FROM	Line TO	Tubing cleaned			Tubing flushed			Diam ID/OD
		Yes	No	N/A	Yes	No	N/A	

TESTED LABEL AFFIXED DATA SHEET ATTACHED

Comments:

Page 2/2	Performed by	☐ WITNESS ☐ REVIEW	☐ WITNESS ☐ REVIEW
Company			
Name			
Date			
Signature			

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