Base Load Power Hub (BLPH)

Dye Penetrant Examination Procedure – Structure

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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.

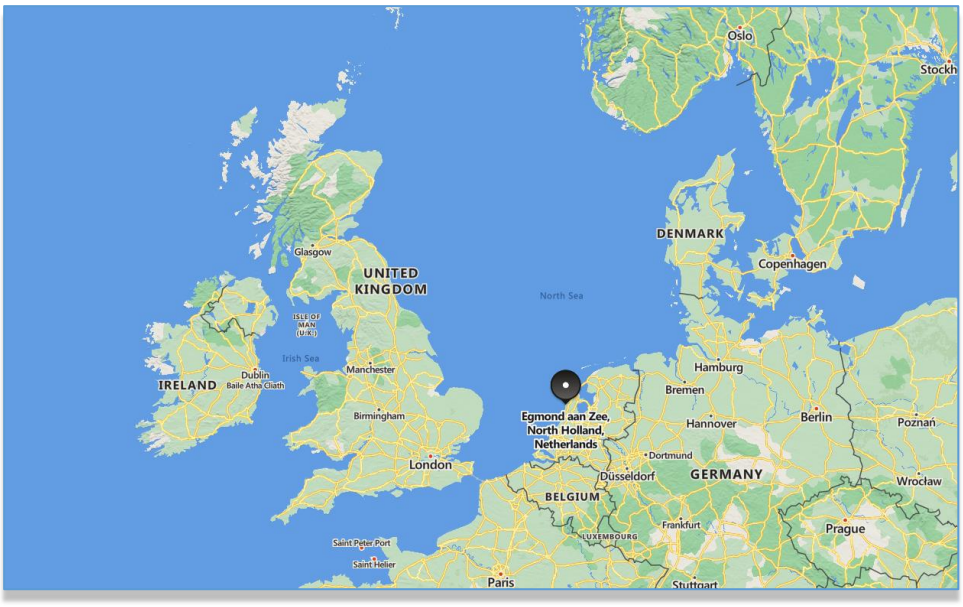


Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map

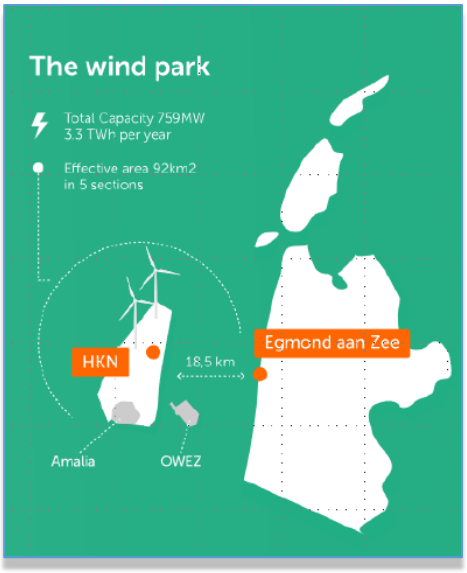


Figure 2 - Wind Park Details

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.

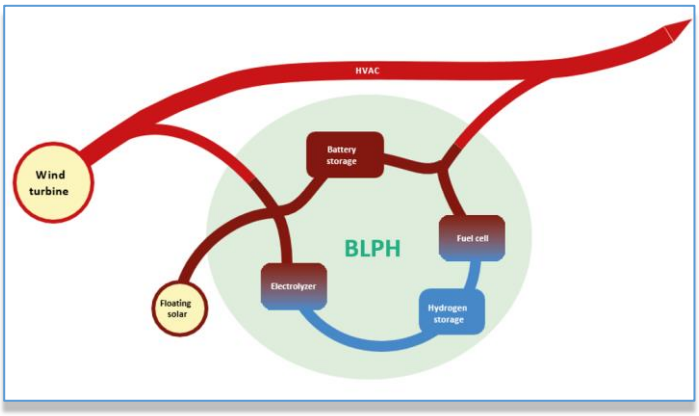


Figure 3 – BLPH Concept

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 refers to the dye penetrant examination and evaluation with colour contrast technique, removable with water for detecting discontinuities which are open to the surface of nonporous materials and welds.
This procedure is applicable to all structural components and shall be used when Magnetic particle Testing is not feasible due to access limitation and on excavation before repair to ensure the complete removal indications.
The welds shall be tested at 100% of external surface and internal surface if accessible if accessible.

Final Non-Destructive Tests (NDT) shall not be carried out sooner than 48 hours after completion of welding.

2.1 REFERENCES (Applicable edition)

Doc. No.	Description
K559-2254-MT-SPE-001	Structural Fabrication Specification
EEMUA_158	Construction Specification for fixed offshore structures
ISO 3452-1	Non destructive testing – Penetrant testing – Part: General principles.
ISO 9712	Non-destructive testing – Qualification and certification of NDT personnel

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
NDT:	Non Destructive test
DYE	Dye Penetrant test

Table 2 - Definitions and Abbreviations

3 PERSONNEL QUALIFICATION

The examiner who carries out dye penetrant test and evaluates indication on all the other welds shall be qualified as a Level 2 or 3 in the applicable method and on the relevant product sector in accordance with the requirements of ISO9712.
The operator shall have a valid near vision acuity test, which permits reading, a minimum of Times Roman N°4.5 or equivalent letters Jaeger 1 at not less than 30 cm with one or both eyes, either corrected or uncorrected. Colour vision shall be sufficient that the candidate can distinguish contrast between the colours used in NDT method.

4 NDT EXTENSION

The extend shall be in accordance to Spec. K559-2254-MT-SPE-001 and will reported on design drawings and inspection test plan.

5 SURFACE PREPARATION

The examination surface and adjacent areas within at least 1 inch (25mm), prior to penetrant application, shall be dry and free of rust, paint, grease, oil, water, welding flux, weld spatters or any other impediments that may prevent the penetrant from entering the discontinuity

Weld should be brushed or ground to remove surface irregularities prior to inspection.

After cleaning the surfaces with cleaner, drying of the surfaces to be examined shall be accomplished by normal evaporation, for at least 5 minutes prior to application of the penetrant.

For welds requiring cap to be ground flush for inspection purposes final PT examination shall be performed after cap removal.

Status of weld shall be reported in PT inspection report.

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6 CONSUMABLES

For execution of Penetrant Test the following materials shall be used:

- Cleaner CGM Velnet / Elite BC1 or MAGNAFLUX SKC-S cleaner
- Penetrant CGM Red W / Elite K71B2p or MAGNAFLUX SKL-SP2 penetrant
- Remover Water
- Developer CGM White W rotrivel U / Elite D112A or MAGNAFLUX SKD-S2 developer

Equivalent products may be used but is not allowed mixed products from different manufacturer.

All products used for the inspection (cleaner, penetrant, developer) shall be with impurity levels of sulphur and halogens in the products shall not exceed 1%.

Products will be detailed on the Technique Sheet.

7 PENETRANT EXAMINATION

The temperature of the surface to be processed shall be from 10°C to 50°C.

Local heating and cooling is permitted provided that parts temperature remains in the required range.

Penetrant shall be applied by spraying.

Penetration dwell time shall be 10 minutes, during that time penetrant shall not be allowed to dry.

If for any reason the penetrant does dry, the examination procedure shall be repeated, beginning with a cleaning of the examination surface.

For temperatures from 5°C up to 10°C, minimum penetrant dwell time shall be 2 times the value listed.

8 EXCESS PENETRAL REMOVAL

After the specified penetration time has elapsed, any excess penetrant remaining on the surface shall be removed with low pressure water.
Excess penetrant shall be removed by washing (rinsing), immersion or wiping using water.
Care shall be taken to minimize the effect of mechanical action caused by the rinsing method.
The remaining traces shall be removed by wiping the surface with a cloth or absorbent paper, lightly moistened with water.
To minimize removal of penetrant from discontinuities, care shall be taken to avoid the use of excess water.
After excess penetrant removal the surface shall be dried.
At all times the surface temperature shall be not raised above 50°C.
Flushing the surface with solvent, following the application of the penetrant and prior to developing, is prohibited.

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9 DEVELOPER APPLICATION

The developer shall be applied after penetrant removal by means of spraying, the time interval shall not exceed that established in the procedure.
The developer shall be thoroughly agitated to ensure adequate dispersion of suspended particles.
The developer shall be applied so that a thin coating is obtained over the entire area of interest. During the developer application the nozzle shall be kept at a distance not less than 12" (300 mm).

10 EVALUATION

Any indication on the detector indicates the possibility of discontinuity (false or true).
Anyhow the true size and type of discontinuities are difficult to evaluate.
It is a good practice that the surface shall be closely observed during the application of the developer.
The drying after removal excess penetrant shall be maximum 5 minutes.
Final interpretation shall be made after allowing the penetrant to bleed-out for at least shall be minimum 15-20 minutes.

11 VIEWING CONDITION

All the testing area shall be easily accessible in safety condition; if necessary, the part shall be moved, to avoid that limited access could interfere with the test results.

The area under test shall be evenly illuminated at a level of not less than 500 lx (lux) daylight or artificial light.

Light meters shall be calibrated at least once a year or whenever a meter has been repaired.

If meters have not been in use for one year or more, calibration shall be done before being used.

12 ACCEPTANCE CRITERIA

The acceptance criteria shall be the same acceptance criteria of magnetic examination in accordance with EEMUA_158:2014, §7.5.5

All surfaces to be examined shall be free of the following:

- Relevant linear indications
- Relevant rounded indications greater than 4mm
- 4 or more relevant rounded indications in a line, separated by 1,5mm or less (Edge to Edge)

12.1 Relevant indications

A "relevant" indication is that caused by defect rather than by weld geometry.

12.2 Linear Indication

A "linear" indication is one having a length greater than three times the width. Intermittent and aligned indications shall be treated as a linear indication.

12.3 Rounded Indication

A "rounded" indication is one having circular or elliptical shape with the length equal or less than three times the width.

13 WELD REPAIR

All defects after repair with a new dye penetrant examination, shall be carried out all over the interested area including 50 mm on either side of defects.
The examination after repair shall be performed not earlier than 48 hours after completion weld.
Welding repairs (or replaced welds) shall be examined with the methods prescribed for the original WPS.

14 CLEANING AFTER EXAMINATION

After examination, external surfaces shall be cleaned by solvent or water and will be dried with cloths.

15 EXAMINATION REPORT

All NDT shall be documented, and all reports shall be generate by database (See attachment 3)
The documentation shall include as minimum the following information, where appropriate:

- contract number;
- applicable procedure specification;
- weld identification;
- material type and dimensions;
- description and location (with sketch where appropriate) of all reportable indications;
- welding process used;
- surface conditions;
- post weld heat treatment (if required)
- temperature of the object;
- consumables
- viewing conditions
- date of testing;
- name and qualification level of inspector;
- approval signature of responsible inspector.

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16 ATTACHMENT

Attachment 1 – Examination Report

Attachment 1 – Examination Report

ROSETTI MARINO

NDE ACTIVITIES - TEST SHEET

RAPPORTO ESAME CON LIQUIDI PENETRANTI

DYE PENETRANT TEST REPORT

DATA DELL'ESAME / Examination Date

FOGLIO N° / sheet n° 1 DI / of

COMMESSA N°/Job No	DISCIPLINA / Discipline	CLIENTE / Client	ORDINE N°/Order N°	PROGETTO/Project

PROCEDURA / Procedure	SPECIFICA / Specification	ACCETTABILITA'/Acceptance levels	INSPECTION TEST PAN / ITP No.	FASE ITP / Phase
Rev.			Rev.	

TECNICA DI SALDATURA Welding process	PROCEDIMENTO DI SALDATURA WPS	FASE DEL CONTROLLO Examination phase	TRATTAMENTO TERMICO / PWHT
			☐ PRIMA DEL TT / Before PWHT ☐ DOPO IL TT / After PWHT ☐ NON APPLICABILE / Not Applicable

OGGETTO Object	MATERIALE / Material	TEMPERATURA PEZZO Piece temperature	ISTRUZIONE DI LAVORO PT PT Work Instruction
☐ MAT. BASE / Parent Material ☐ SALDATURA / Weld Metal			

CONDIZIONI DI VISIONE / Viewing conditions

☐ NATURALE / Natural light ☐ ARTIFICIALE / Artificial light TIPO ILLUMINATORE / Lighting equipment

☐ LAMPADA DI WOOD / Wood Lamp ☐ ALTRO / Other ILLUMINAZIONE / Lighting intensity

STATO DELLA SUPERFICIE / Surface condition

☐ COME SALDATO / As welded ☐ SPAZZOLATO / As brushed ☐ LAV. DI MACCHINA / As machined ☐ COME CALANDRATO / As calendered ☐ ALTRO / Other

☐ MOLATO / As ground ☐ COME LAMINATO / As rolled ☐ GREZZO / As forged ☐ VERNICIATO / As painted

PULITURA PRELIMINARE / Preliminary Cleaning	PULITORE PRELIMINARE (Marca e tipo) / Cleaner (trade and type)	Batch N.
☐ ACQUA / Water ☐ STRACCI / Rags ☐ SOLVENTE / Solvent ☐ ALTRO / Other		

PENETRANTE (Marca e tipo)/ Penetrant (trade and type)	Batch N.	APPLICAZIONE PENETRANTE / Penetrant Application

RIMOZIONE PENETRANTE / Removal penetrant	PULITORE PENETRANTE (Marca e tipo)/ Penetrant Remover (trade and type)
☐ ACQUA / Water ☐ STRACCI / Rags ☐ SOLVENTE / Solvent ☐ ALTRO / Other	

RIVELATORE (Marca e tipo) / Developer (trade and type)	Batch N.	ESSICAZIONE / Drying process

APPLICAZIONE RIVELATORE / Developer application	TEMPO MINIMO PENETRAZIONE / Minimum Penetrating time (minuti/minutes)

TEMPO DI LETTURA / Checking time (minuti/minutes)		INTERVALLO APPLICAZIONE RIVELATORE/time interval developer application
min.	max	max

PULITORE POST-CONTROLLO / Cleaner after examination

☐ ACQUA / Water ☐ STRACCI / Rags ☐ SOLVENTE / Solvent ☐ ALTRO / Other

OGGETTO CONTROLLATO / Object tested

COMPONENTE / Item

Nr. RAPPORTO Report Nr.	SALDATURA / Weld Number	DISEGNO / FOGLIO DWG / sheet	MARCA / Mark	DIMENSIONI Dimension	SPESSORE Thickness	TIPO DI GIUNTO Type of joint	ESTENSIONE DEL CONTROLLO / Extent of testing (%)	ESITO / Result

NOTE / Remarks

TECNICO CND Livello 2 NDT Technician Level 2	CONTROLLO QUALITA' Q.C. Supervisor	ISPETTORE CONTRATTISTA Contractor Repr.	ISPETTORE CLIENTE Company Repr.	ISPETTORE TERZA PARTE Third Party Inspector
Company: Operator:				

MOD-PRQ-23 Rev. 2018-00

Second page of weld repair (if any), will be issued by technician

ROSETTI MARINO	**RAPPORTO ESAME CON LIQUIDI PENETRANTI** DYE PENETRANT TEST REPORT	N° Pag./Sheet **Data** / Date **Comm./**Job **Disegno/**Dwg
COMMITTENTE / Customer		
OGGETTO CONTROLLATO/ Tested object		

LOCALIZZAZIONE INDICAZIONI / INDICATIONS LOCATION									
INDICAZIONI (identificazione) /Indications (identification)									
Lx = DISTANZA INDICAZIONE DA X / Flaw distance from X									
L = LUNGHEZZA INDICAZIONE / Flaw lenght									
Z = PROFONDITA' INDICAZIONE / Flaw depth									
Ly= DISTANZA INDICAZIONE DA Y / Flaw distance from Y									
H = ALTEZZA DELL'INDICAZIONE / Flaw height									
X= RIFERIMENTO DIREZIONE LONGITUDINALE / Reference longitudinal direction									
Y= RIFERIMENTO DIREZIONE TRASVERSALE / Reference transverse direction									
A / R = ACCETTABILE-RIPARARE / Acceptable-repair									

DISEGNO / SKETCH

TECNICO CND Livello 2 NDT Technician Level 2	**CONTROLLO QUALITA'** Q.C. Supervisor	**ISPETTORE CONTRATTISTA**	**ISPETTORE CLIENTE** Company Repr.	**ISP. TERZA PARTE** Third Party Inspector
Company: Operator:				