Base Load Power Hub (BLPH)

Forming procedure

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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.

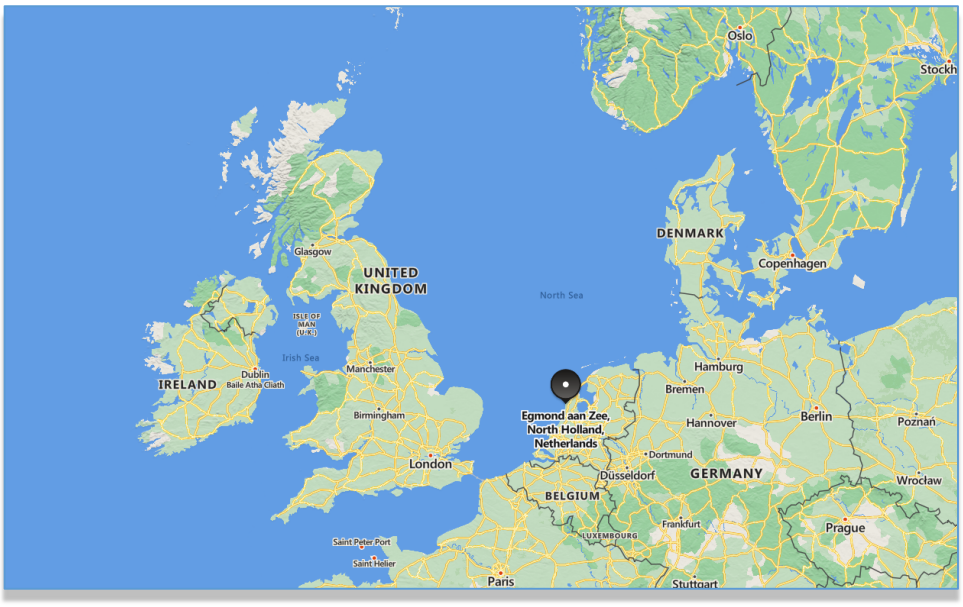


Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map

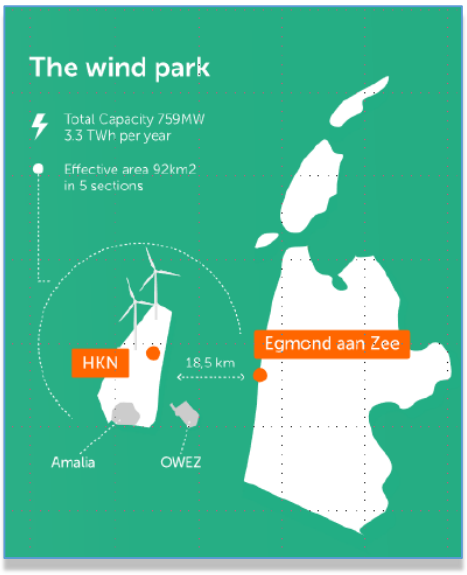


Figure 2 - Wind Park Details

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.

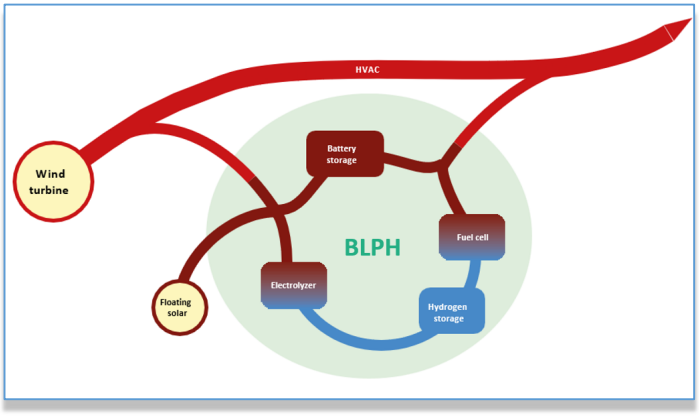


Figure 3 – BLPH Concept

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.

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2 DOCUMENT SCOPE

The scope of this procedure is to list the phases activities for plate Carbon Steel material forming of Base Load Power Hub (BLPH).

2.1 REFERENCES

Doc. No.	Rev.	Date	Description - Title
K559-2254-MT-SPE-001	01	06/03/2023	Structural Fabrication Specification
EEMUA 158	Third ededition	2014	Construction Specification for Fixed Offshore Structures.
ISO 19902	Second edition	2020-11	Petroleum and Natural Gas Industries - Fixed Steel Offshore Structures.
ISO 19901-3	Dec-2014	Dec-2014	Petroleum and Natural Gas Industries - Specific Requirements for Offshore Structures - Topsides Structure.

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
CA	Certifying Authority
DP	Dye Penetrant
ITP	Inspection and Test Plan
MPI	Magnetic Particle Inspection
NDT	Non-Destructive Testing
QA	Quality Assurance
QC	Quality Control
UT	Ultrasonic Testing
WI	Welding Inspector
WS	Welding Supervisor
WT	Wall Thickness

3 RESPONSIBILITIES AND TASKS

- Welding Engineer:

He is responsible for the development and update of present procedure and relevant qualification.

- Workshop Manager / Workshop Supervisor:

He shall verify that during the different phases, the coordination, execution and all concerns relevant to HSE and safety.

- QC Personnel / QC Inspector:

He shall verify that during the different phases, materials are handled in accordance with this procedure, free from damages and shall verify the size of the elements.

- Forming operators:

They are responsible for applying the provisions included in this procedure.

4. ROLLING

4.1 SAFETY CONSIDERATIONS

The equipment used during rolling is dangerous. Any machine able to deliver great pressure and power be handled with extreme care.
The technician using these type or machines must be properly trained and safety conscious at all times.
Precautions include:

1) Wear protective goggles while heating;
2) Be careful of where the plate edge is pointed at all times;
3) Wear protective gloves and clothing;
4) Always be in a stable, secure position prior to press start and start material deformation;
5) Follow proper procedures;
6) Check safety tags and machine maintenance is done;

4.2 PREPARATION AND SURFACE CONDITIONS

Plates having surface conditions that may impair or affect the forming operation or which may have scales incorporated into their surface shall be restored.

All defects that may appear before or after forming shall not exceed 1,5 mm in depth.

Rolls and plates to be rolled shall be clean in order not to produce permanent prints on their surface.

Deep defects shall be measured by Vernier caliper.

Material preparation:

the plate shall be free from cutting edges, surface visible defects, the surface shall be clean & flat and shall be free of starting layer and scratches.

5. EQUIPMENT

- Rolling machine (3 and 4 rollers units)
- Trimming machine

6. ROLLING OPERATIONS

Rolling operation is performed by two different operations:

- Forming of the edges to be welded (Pre-bending phase)
- Rolling operation.

7. FORMING OF THE EDGES TO BE WELDED

The pre-bending phase corresponds to rolling of the plate edges.

Sometimes this operation requires the plates to be cut longer (perpendicularly to the edges of the longitudinal weld) and to be subsequently trimmed.

The extra length is a function of the thickness of the plate and of the diameter of the tubular member to be formed. As far as extra lengths are concerned, it shall be made reference to the specific diagrams of the rolling machine (the extra length shall be approx. 2 times the plate thickness).

When this method is to be applied, it is necessary to execute a preliminary rolling operation.

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8. PRELIMINARY ROLLING

This operation shall be executed for removing the peaking of longitudinal weld joints.

To remove this type of defect, it is necessary to roll the two edges of the plates and the extra length shall be cut off afterwards.

Preliminary rolling is followed by another rolling operation as described in the following paragraph.

9. ROLLING OPERATION

The plate prepared as indicated at point 10 Figure 1, shall be placed in the rolling machine always taking care of the following:

- the plate shall be placed perpendicularly to the rolls
- plate identification marks shall be on the external surface of the course to be obtained

When necessary for handling reasons, this mark may be stamped on the internal surface of the courses and subsequently transferred outside.

For all those cases which do not need a hot rolling, the rolling operation shall be executed at room temperature and the plate temperature shall never be less than 0°C.

In the case the plate temperature is lower than 0°C, the plate shall be regularly warmed up to 15°C in all its thickness prior to rolling operation.

During the rolling phase and prior to longitudinal welding, the bending radius and the alignment of the bevels shall be inspected.

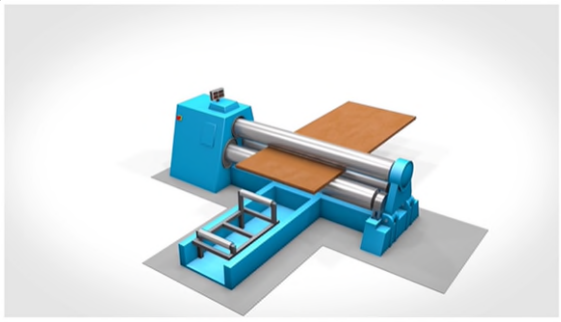
When necessary, after longitudinal seam welding, tubular shall be rolled once again ("calibration").

In this case, applicable NDE shall be executed after the "calibration" phase.

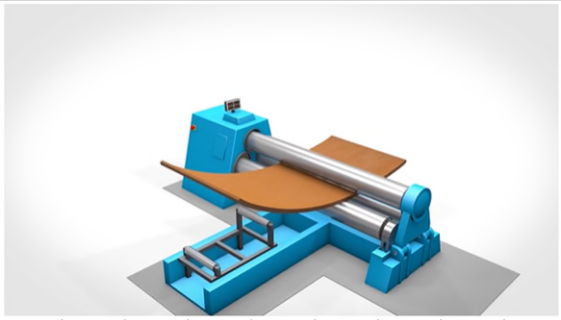
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10. WORKING SEQUENCE

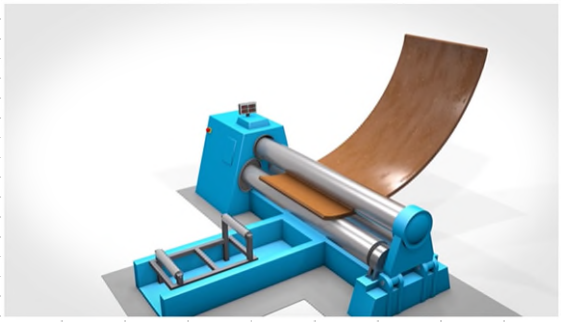
1. plate is cut to size and then is placed in rolling machine



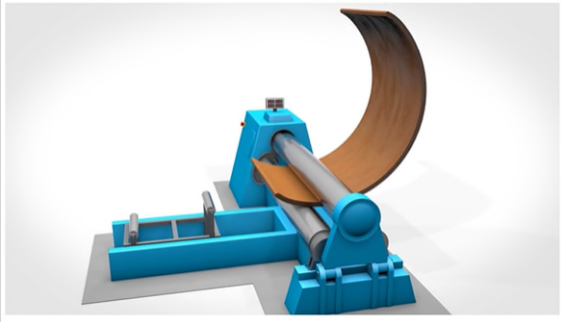
2. plate start rolling inside rolling machine by steps and by several passages



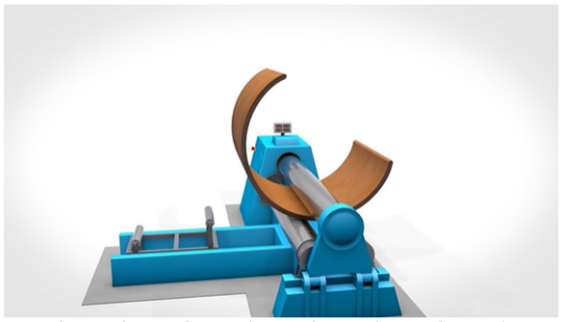
3. number of passages inside machine depends on diameter to be reached and on thickness of plate.



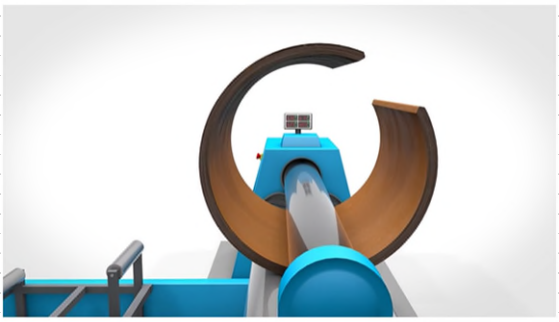
4. several passages back and fourth may be required to reach final size



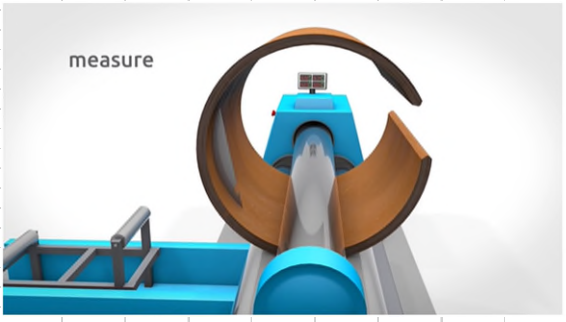
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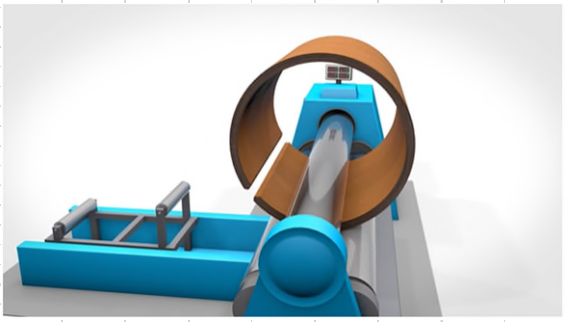
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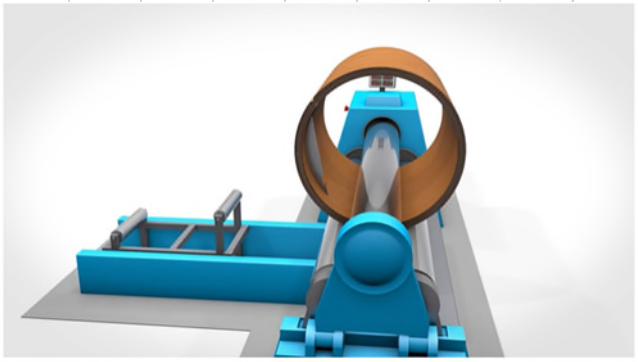
5. step by step, once we are near to size, the machine operators stars to check if we are on correct size



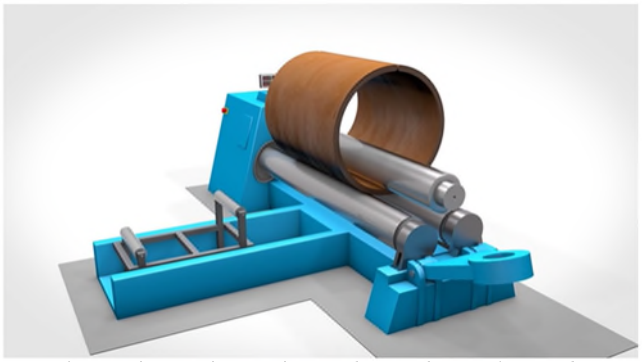
NOTE: if not yet in sieze step 4 & step 5 are then repeated



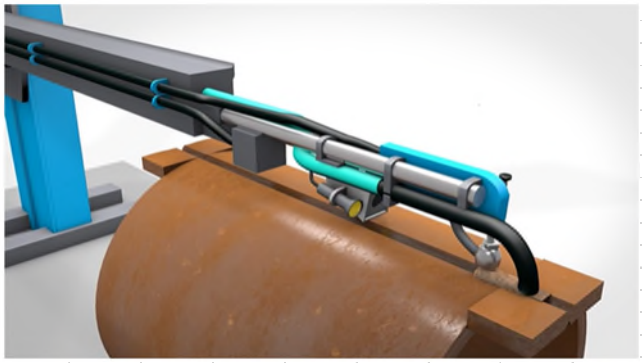
6.once we are on correct size the rolling stops



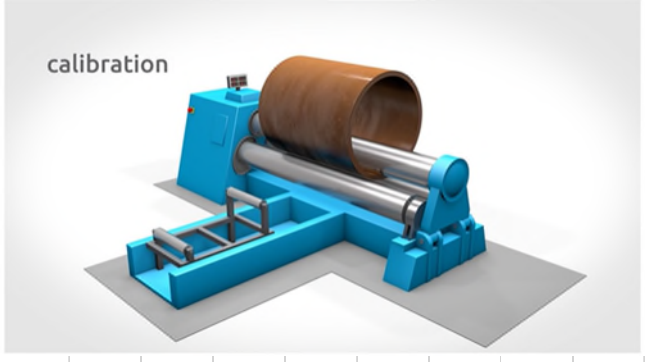
7.once we are on correct size the tubular is unloaded from machine and secured by tack weld



8.tack weld



9.Tubular is inserted again in machine for final calibration and to reduce ovalization



11. MANUFACTURING TOLERANCES

Allowed dimensional tolerances are defined in the procedure relevant to dimensional control of prefabricated components.

12. BENDING

12.1 BENDING OPERATION

The cold bending of plates is performed by following working steps.

The stepwise bending – calculated with a computer program - is marked onto the plate.

The plate is deposited on 2 supports, the distance between can be individually adjusted.

The bending effect is achieved by means of a wedge pressed onto the plate between the supports. Once a pressing operation is performed and the wedge is removed, the plate is moved forward to a predetermined progression for further stepwise bending.

After bending one half of the plate, the other half is bent in the same way as describe above.

13. INSPECTIONS

The items to be bent shall be without primer application and free from debris that can be produce permanent marking in to the surfaces (bare steel).

The contour of the bent area is checked by means of a template at both ends and in the middle of the plate. If the radius of the bent area is in conformance with the required dimensions, the bending operation proceeds.

Surface shall be free from pits and craters.

Surface shall be free from visible roll-overs/ laminations

Indentations and roll marks shall be smooth.

For deep marks measurements Vernier caliper shall be use.

Non conformance pieces shall be segregated and WI / Welding Department shall be informed

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