Base Load Power Hub (BLPH)

SPECIFICATION FOR TRANSPORTATION AND INSTALLATION

Document Number: 123A90-DDL-TI-SP-99014

Document Class: 2

01	10/09/2024	Accepted for Construction (AFC)	A.Balzarotti	T.Balestra	D.LoSerzo
00	05/12/2023	Issue for Review (IFR)	A.Balzarotti	T.Balestra	D.LoSerzo
Rev.	Date	Description	Prepared	Reviewed	Approved
TECON					

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Revision / Change Log

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

HOLDS LIST

No.	Description
1	
2	
3	
4	

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Attachment 4 – Field Information OoE.

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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.

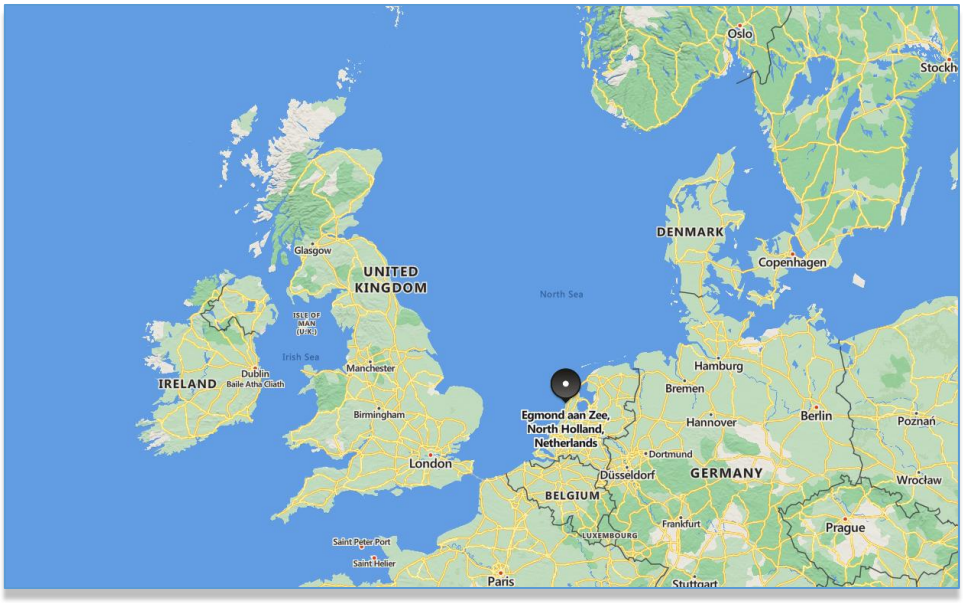


Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map

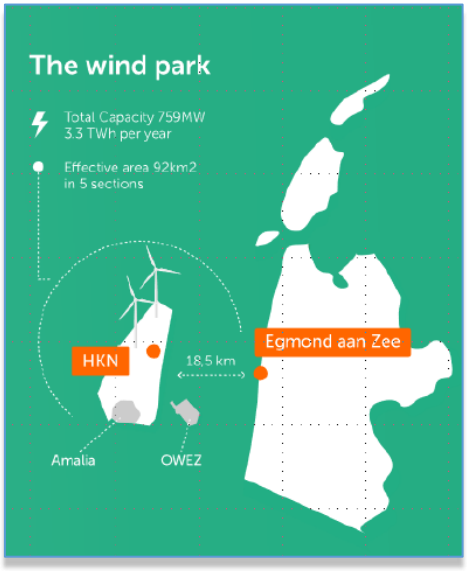


Figure 2 - Wind Park Details

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.

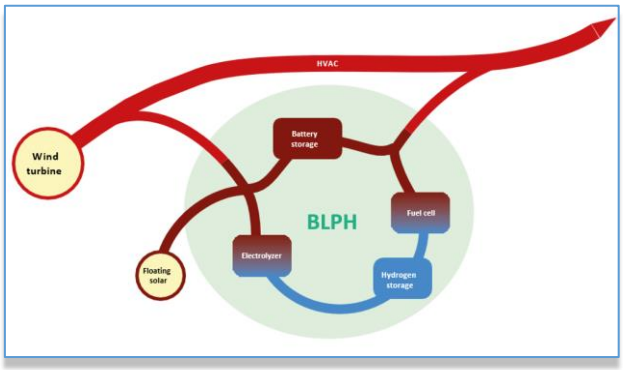


Figure 3 – BLPH Concept

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

The purpose of this technical specification is providing all necessary data, information, and instructions in order to make DEME (Appointed Installation Sub-contractor) and HEBO (Appointed Transportation Sub-contractor) fully aware of the requirements to be met in the preparation and execution of installation of BLPH platform components consisting of:

- N. 1 Transition Piece
- N. 1 Topside
- N.1 Caisson Frame supporting n.3 caissons.

An overall view of the platform 3D model is shown in the next figure 2.1.

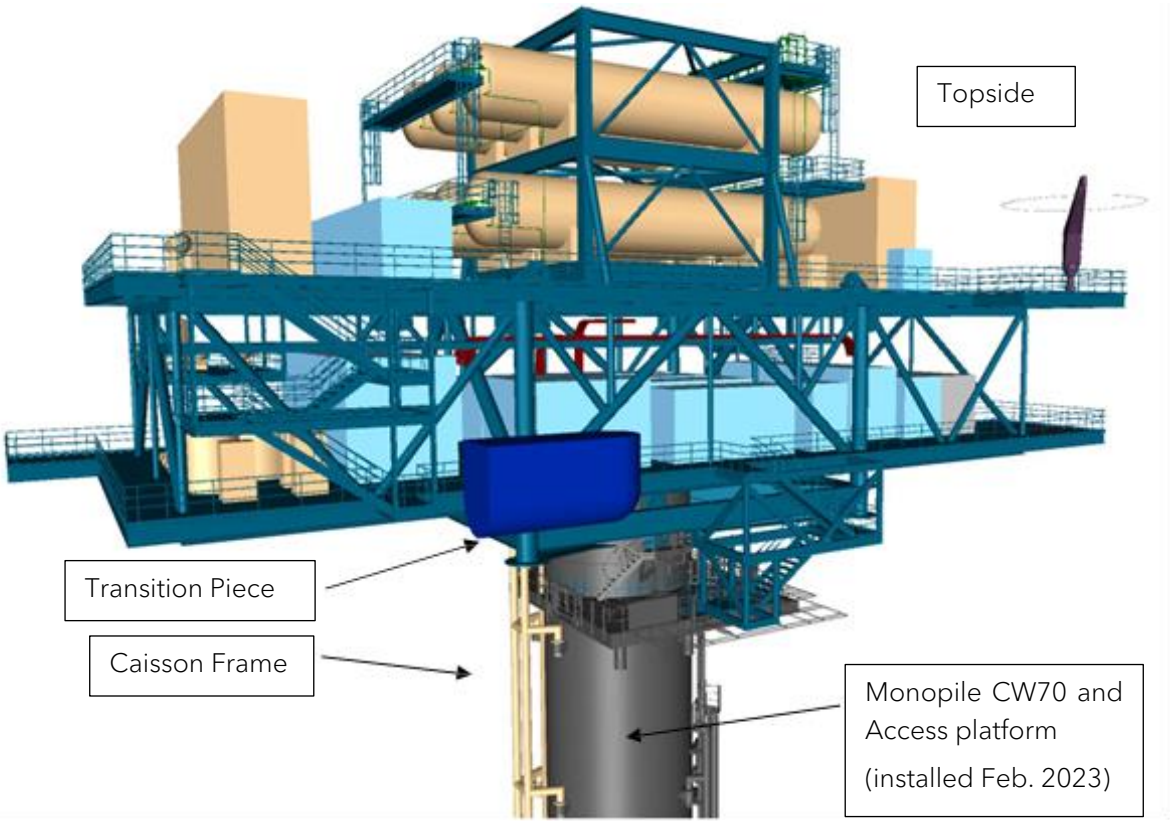


Figure 4 – BLPH Topside

2.1 REFERENCES

Doc. No.	Description
1. DNVGL-ST-N001	DNV GL - Marine operation and marine warranty - 2021
2. DEP 37.91.10.11-Gen.	Mobile Moorings (AMENDMENTS/SUPPLEMENTS TO API RP 2SK, API RP 2SM AND API RP 2I), Feb 2021
3. DEP 37.90.10.32-Gen	Selection and operation of dynamically positioned (DP) vessels, Feb 2021
4. IMO-SOLAS	Safety of Life at Sea, Consolidated Edition.
5. API RP 2X	Ultrasonic and Magnetic Particle Testing

Table 1 - Reference Documents

2.2 DEFINITIONS AND ABBREVIATIONS

2.2.1 Definitions

COMPANY or Client (CPY):	Crosswind
CONTRACTOR (CTR):	ROSETTI MARINO S.p.A.
PROJECT:	HOLLANDSE KUST NOORD WIND PARK Project

Table 2 - Definitions

2.2.2 Abbreviations

NA	Not applicable
BP	Bollard Pull
BLPH	Base Load Power Hub
COG	Centre of Gravity
DAF	Dynamic Amplification Factor
DP	Dynamic Positioning system
EL	Elevation
FC	Fabrication Subcontractor
HLV	Heavy Lift Vessel
LAT	Lower Astronomical Tide
MBL	Minimum breaking load
MP	Monopile

MAP	Main Access platform
MWS	Marine Warranty surveyor
NDT	Non-destructive testing
OD	Outside Diameter
SOW	Scope of Work
T	Metric tons
TEF	Termination Efficiency Factor
TOS	Top of sSteel
THK	Thickness
TPR	Towline Pull Requirement
WT	Wall Thickness
WLL	Work Limit Load
WTW	Walk to work Platform
OoE	Oceams of Energies

Table 3 - Abbreviations

3 PROJECT DOCUMENTATION

3.1 DESIGN DATA

[11] 123A90-DDL-ST-SP-90017 Structural Design Premises

Note: Document [11] is considered for information only and as such will not by reviewed by T and I subcontractors.

3.2 PROJECT SPECIFICATIONS

[12] 123A90-DDL-ST-SP-90018 Structural Material Specification;

[13] 123A90-DDL-ST-SP-90019 Structural Fabrication Specification;

3.3 WEIGHT CONTROL REPORT

[14] 123A90-PML-MD-PRO-01002 Weight Control Procedure

[15] 123A90-DDL-MD-RE-01006 Monthly Weight Report

Note: Documents [14] & [15] are considered for information only.

3.4 DETAIL DESIGN REPORT

[16] 123A90-DDL-ST-RE-90002 BLPH PLATFORM - TRANSPORTATION ANALYSIS;

[17] 123A90-DDL-ST-RE-90003 BLPH PLATFORM - TRANSPORTATION FATIGUE ANALYSIS;

[18] 123A90-DDL-ST-RE-90004 BLPH PLATFORM - LIFTING ANALYSIS

[19] 123A90-DDL-ST-RE-90005 BLPH PLATFORM - JOINT CHECK DESIGN REPORT

[20] 123A90-DDL-ST-RE-90009 TP - TRANSPORTATION ANALYSIS

[21] 123A90-DDL-ST-RE-90010 TP - TRANSPORTATION FATIGUE ANALYSIS

[22] 123A90-DDL-ST-RE-90011 TP - LIFTING ANALYSIS

[23] 123A90-DDL-ST-RE-90012 TP - JOINT CHECK DESIGN REPORT

[24] 123A90-DDL-ST-RE-90013 TP-MP FLANGE CONNECTION VERIFICATION

[25] 123A90-DDL-ST-RE-90015 CAISSONS - TRANSPORTATION ANALYSIS

[26] 123A90-DDL-ST-RE-90016 CAISSONS - LIFTING ANALYSIS

3.5 DETAIL DESIGN DRAWINGS

Dwg. No.	*DESCRIPTION*
[27] 123A90-DDL-ST-DA-90024	3D GENERAL ARRANGEMENT
[28] 123A90-DDL-ST-DD-90025	DRAWINGS LIST
[29] 123A90-DDL-ST-DD-90026	STANDARD DRAWINGS - GENERAL NOTES

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[30]123A90-DDL-ST-DD-90042	TOPSIDE - PRIMARY STEEL - ELEVATION ROW A
[31] 123A90-DDL-ST-DD-90043	TOPSIDE - PRIMARY STEEL - ELEVATION ROW B
[32] 123A90-DDL-ST-DD-90044	TOPSIDE - PRIMARY STEEL - ELEVATION ROW C
[33] 123A90-DDL-ST-DD-90045	TOPSIDE - PRIMARY STEEL - ELEVATION ROW 1
[34] 123A90-DDL-ST-DD-90046	TOPSIDE - PRIMARY STEEL - ELEVATION ROW 3
[35] 123A90-DDL-ST-DD-90047	TOPSIDE - PRIMARY STEEL - ELEVATION ROW 5
[36] 123A90-DDL-ST-DD-90048	TOPSIDE - PRIMARY STEEL - ELEVATION ROW 2 & 4
[37] 123A90-DDL-ST-DD-90049	TOPSIDE - PRIMARY STEEL - PLAN EL +23310
[38] 123A90-DDL-ST-DD-90050	TOPSIDE - PRIMARY STEEL - PLAN EL +30310
[39] 123A90-DDL-ST-DD-90051	TOPSIDE - PRIMARY JOINTS – LOWER DECK
[40] 123A90-DDL-ST-DD-90052	TOPSIDE - PRIMARY JOINTS – UPPER DECK
[41] 123A90-DDL-ST-DD-90053	TOPSIDE - PRIMARY JOINTS - PLAN AT EL +30310 TOS - CRANE PEDESTAL
[42] 123A90-DDL-ST-DA-90055	TOPSIDE - LIFTING POINTS - GENERAL ARRANGEMENT
[43] 123A90-DDL-ST-DD-90056	TOPSIDE - LIFTING POINTS - DETAILS
[44] 123A90-DDL-ST-DD-90057	TOPSIDE - SECONDARY STEEL - PLAN AT EL 23310 TOS 30310
[45] 123A90-DDL-ST-DD-90058	TOPSIDE - SECONDARY STEEL - PLAN +30310 TOP
[46] 123A90-DDL-ST-DD-90063	TOPSIDE - WALKWAYS & STAIRS - ASSEMBLY & DETAILS
[47] 123A90-DDL-ST-DD-90064	TOPSIDE - WALKWAYS & STAIRS - ASSEMBLY & DETAILS
[48] 123A90-DDL-ST-DD-90065	TOPSIDE - WALKWAYS & STAIRS - ASSEMBLY & DETAILS
[49] 123A90-DDL-ST-DD-90066	TOPSIDE - WALKWAYS & STAIRS - ASSEMBLY & DETAILS
[50] 123A90-DDL-ST-DD-90071	STORAGE VESSEL - PRIMARY STEEL - PLAN EL +2
[51] 123A90-DDL-ST-DD-90072	STORAGE VESSEL - PRIMARY STEEL - PLAN EL +3
[52] 123A90-DDL-ST-DD-90076	TOPSIDE - IDENTIFICATION PANEL
[53] 123A90-DDL-ST-DD-90077	TOPSIDE - TERTIARY STRUCTURES
[54] 123A90-DDL-ST-DD-90078	TP - PRIMARY STEEL - ELEVATION ROW A
[55] 123A90-DDL-ST-DD-90079	TP - PRIMARY STEEL - ELEVATION ROW B
[56] 123A90-DDL-ST-DD-90080	TP - PRIMARY STEEL - ELEVATION ROW C
[57] 123A90-DDL-ST-DD-90081	TP - PRIMARY STEEL - ELEVATION ROW 2
[58] 123A90-DDL-ST-DD-90082	TP - PRIMARY STEEL - ELEVATION ROW 4

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[59] 123A90-DDL-ST-DD-90083 TP - PRIMARY STEEL - PLAN AT EL +17050 TOS (FLANGE CONNECTION)

[60] 123A90-DDL-ST-DD-90084 TP - PRIMARY STEEL - PLAN AT EL +17300 TO +19242 TOS

[61] 123A90-DDL-ST-DD-90085 TP - PRIMARY STEEL - PLAN AT EL +21710 TOS

[62] 123A90-DDL-ST-DD-90086 TP - TOPSIDE SUPPORT POINTS

[63] 123A90-DDL-ST-DA-90087 TP - LIFTING POINTS - GENERAL ARRANGEMENT

[64] 123A90-DDL-ST-DD-90088 TP - LIFTING POINTS - DETAILS

[65] 123A90-DDL-ST-DD-90089 TP - TOPSIDE CONNECTION DETAILS

[66] 123A90-DDL-ST-DD-90090 TP - WALKWAYS & STAIRS - ACCESS PLATFORM

[67] 123A90-DDL-ST-DD-90091 TP - WALKWAYS & STAIRS - ACCESS PLATFORM

[68] 123A90-DDL-ST-DD-90092 TP - WALKWAYS & STAIRS - ACCESS PLATFORM

[69] 123A90-DDL-ST-DD-90093 TP - WALKWAYS & STAIRS - ACCESS PLATFORM

[70] 123A90-DDL-ST-DD-90094 CAISSONS ELEVATION

[71] 123A90-DDL-ST-DD-90095 CAISSONS DETAILS

[72] 123A90-DDL-ST-DD-90096 CAISSON DETAILS

[73] 123A90-DDL-TI-DD-99015 BARGE LAYOUT

3.6 OTHER REFERENCE DOCUMENTS

[74] K559-2254-ST-PHI-001 Structural Topsides Design & Installation Philosophy.

[75] K559-2254-WC-REP-001-Rev.2 Weight Report

Project Documentation will be updated by RM to be consistent with DEME installation methods as well as new documents produced by CPY during the project execution phase.

DEME will be reviewing and commenting the received documentation and drawings / concepts which may need to be adjusted to suit CTR installation methods.

4 GENERAL PROJECT INFORMATION

4.1 PLATFORM LOCATION AND WATER DEPTH

The CW70 Monopile is located located about 18.5km off the coast of Netherlands within the offshore Hollandse Kust Noord (HKN) wind farm.

Monopile and access platform have been installed in Feb. 2023 by Van Oord.

The location of new BLPH TP and Topside facilities is summarized below in ETRS 1989, UTM Zone 31 North grid co-ordinates:

PLATFORM NAME	WATER DEPTH (m)	LOCATION (ref. Attachment 2)		ORIENTATION Wrt True North
		EASTING (m)	NORTHING (m)	
BLPH	20.50 – 22.20	590718.95	5841602.42	65° - Clockwise

CW70 MP is oriented 65° with respect to geographical North. Platform orientation is shown in Figure 5 and location in Fig. 6:

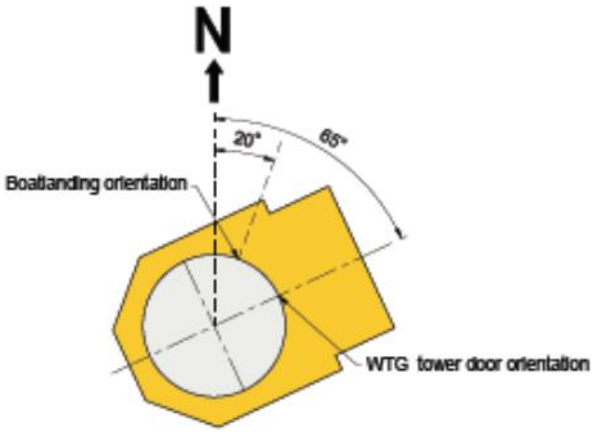


Figure 4.1 – CW70 orientation

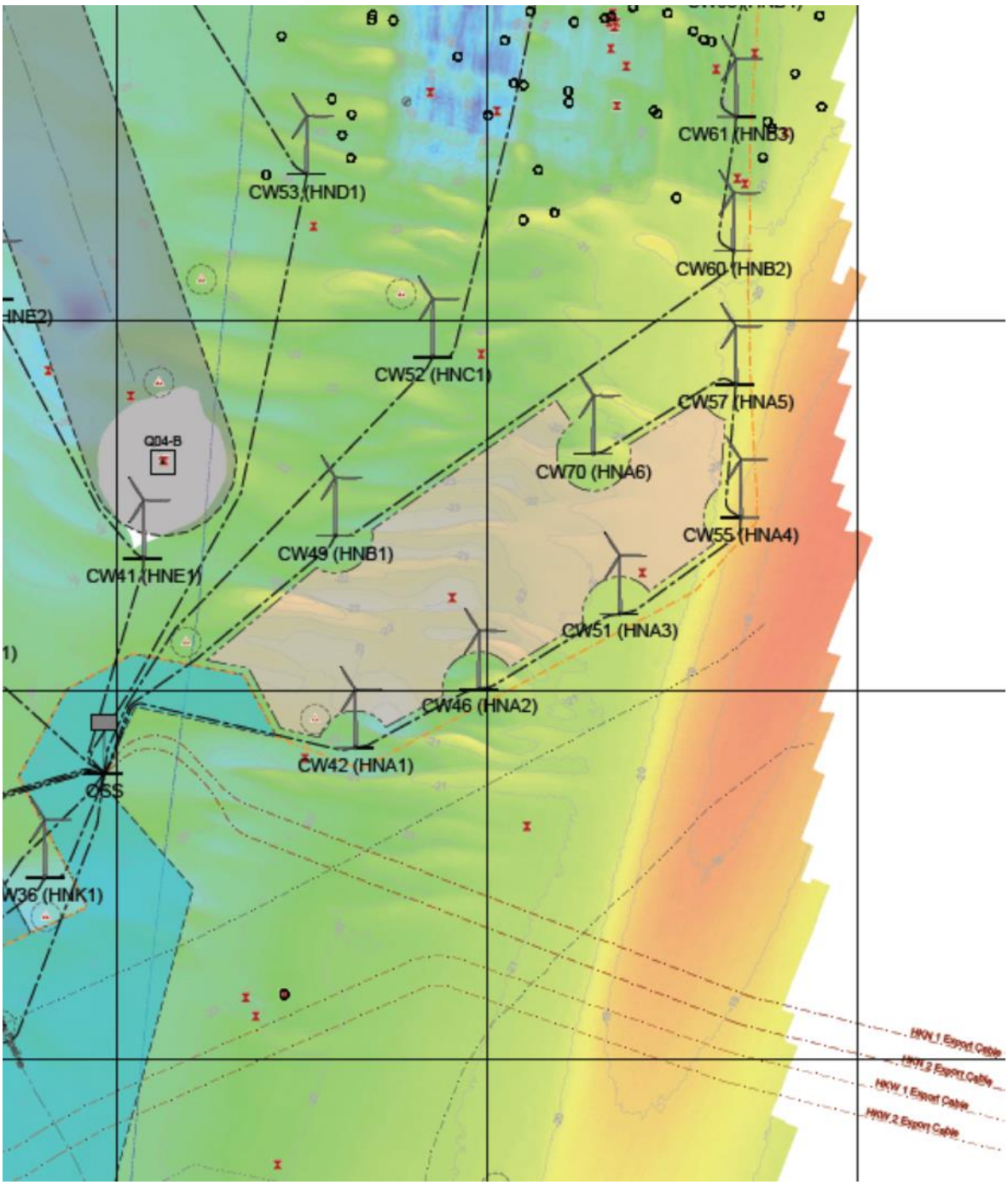


Figure 4.2 – CW70 location

4.2 ENVIRONMENTAL DATA

The Environmental data supplied by Company are reported in document Ref. [11] "Structural Design Premises" and are reported below.

4.2.1 Water Levels

Mean Sea Level (MSL) is +1.1 m above LAT, Ref. [11].

Maximum and minimum water levels for a range of return periods are provided in Table 4.1.

Extreme Water Level	Return period						
	1	2	5	10	50	100	1,000
Max	3.2	3.4	3.5	3.7	4.0	4.1	4.5
Min	-0.5	-0.6	-0.7	-0.8	-1.0	-1.1	-1.4

Table 4.1 - Extreme Water Levels including Storm Surge, Ref. [11].

4.2.2 Tide

Tidal water levels are given in Table 4.2.

Tidal Value	Relative to LAT	Relative to MSL
Highest Astronomical Tide	2.2	1.0
Mean High Water Spring	1.9	0.8
Mean High Water Neap	1.6	0.5
Mean Sea Level	1.1	0
Mean Low Water Neap	0.6	-0.5
Mean Low Water Spring	0.3	-0.9
Lowest Astronomical Tide	0	-1.1

Table 4.2 - Extreme Tidal Levels, Ref. [11].

4.2.3 Wind Data

Omni-Directional wind speed data are reported in Table 4.3, Ref. [11].

Averaging Time	Return period (years)						
	1	2	5	10	50	100	1000
1hr	31.8	33.4	35.1	36.4	39.1	40.1	43.4
10 min	33.7	35.5	37.4	38.8	41.7	42.9	46.5
3s	39.4	41.6	44.1	45.9	49.7	51.1	56.0

Table 4.3 - Omni-Directional Wind velocities [m/s] at 125 m MSL

Wind speeds are provided at 125m MSL. Wind speeds at any specified averaging time or elevation, will be calculated according to following equations:

U(z, t) = U(z) * [1 - 0.41 * Iu(z) * ln(t/t0)]

U(z) = 1-hour mean wind speed given by:

U(z) = U0 * [1 + C * ln(z/zr)]

C = 0.0573 * (1 + 0.15 * U0)1/2

Iu = 0.06 * [1 + 0.043 * U0] * (z/zr)-0.22

U0 = 1-hour average at the reference elevation, zr

zr = 10 m above sea level.

Directional exceedance data for wind is presented in Figure 4.3. The wind predominantly blows from the south- west.

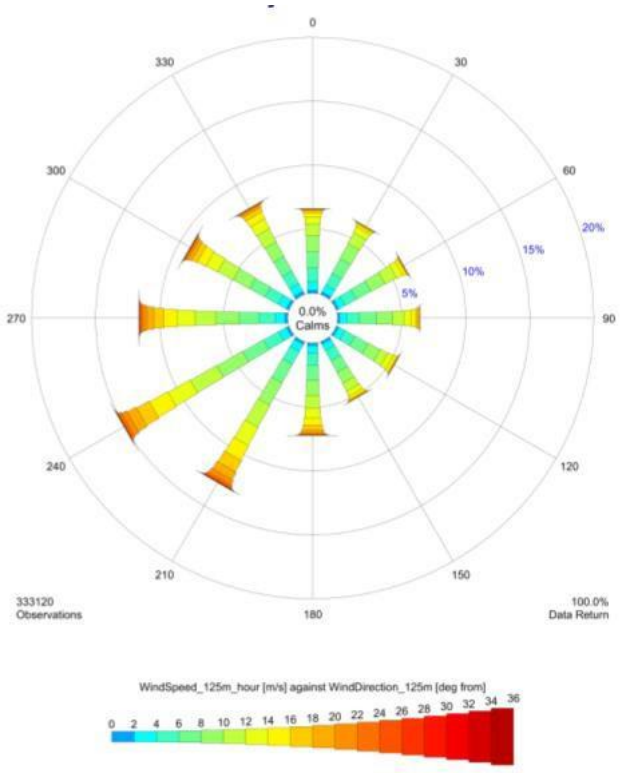


Figure 4.3 - Mean Hourly Wind Speed Distribution at 125 m MSL

4.3 WAVES AND CURRENT

4.3.1 Normal Sea State (NSS)

From ref. Ref.[11], significant wave height with recurrence period of 1 year and associated peak period are:

- Hs,1y = 5.6m;
- Tp = 10.0s.

The omnidirectional the most severe Normal Sea State (NSS) is presented in the next Table including current and tide.

Hs [m]	Tp [s]	WL [m]	Vc_{avg} [m/s]	$V_{c;SWL}$ [m/s]
6.44	10.17	2.47	0.30	0.99

Vc_{avg} = total depth averaged current (tidal + wind)
$V_{c;SWL}$ = total current (tidal + wind) at Still Water Level

Table 4.4 – Most severe NSS load case for omni-directional wave

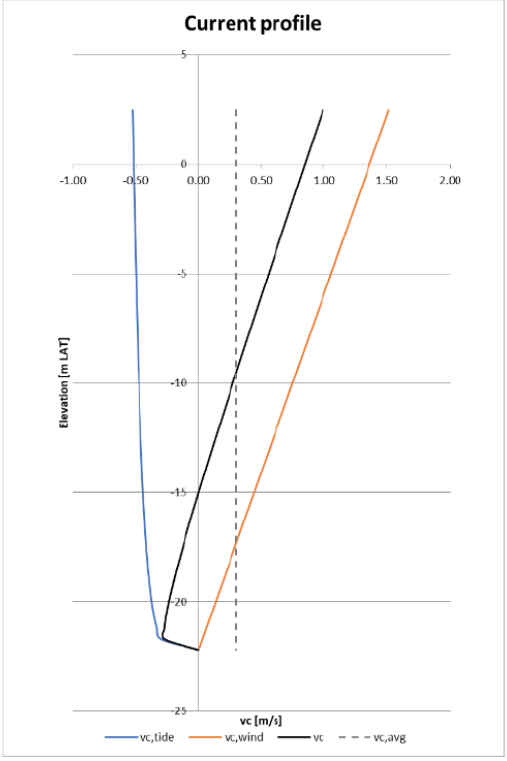


Table 4.5 - Current profile for NSS

4.4 WAVE DATA FOR SEA TRANSPORT FATIGUE

Omnidirectional scatter diagram applicable for the route and season with corresponding exposure and tow duration will be provided by Transportation study.

4.5 SPLASH ZONE

The design splash zone is

- Upper limit external splash zone = +7.0 [m] LAT;
- Lower limit external splash zone = -2.8 [m] LAT.

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5 MP, TP AND TOPSIDE DESCRIPTION

5.1 MONOPILE

The monopile for the BLPH is referred to as CW70 (HNA6). The monopile has been installed in Feb. 2023.

5.2 BLPH TOPSIDES LAYOUT BASIS

The BLPH comprises of two main deck levels with overall deck plan dimensions of 40m x 16m, excluding external walkways, laydown areas and stairs, with an overall deck height of 7 m between decks. There are currently 6 hydrogen storage vessels which lie horizontally, aligned north - south, within the PAU structure located above the upper deck.

The Topsides layout is shown in Figure 5.1.

The Topsides in unmanned and there is no helideck. Main access is via Walk to Work (W2W) vessel with W2W platforms provided on the lower deck on North side. Ladder access to sea for small Crew Transfer Vessel (CTV) access is also provided.

Deck elevations are:

- Target top of TP, El. + 22.310 m;
- Lower Deck, El. + 23.310 m ToS;
- Upper Deck, El. + 30.310 m ToS.

The topside not-to-exceed weighed weights (excluding rigging) are:

Topside Lifting	
Expected Lift weight	2000 t (contractual NTE with installation contractor)
CoG shift factor	5% (0.80m x 2.0m)
Weight Contingency factor	3% (based on weighing apparatus tolerance)
Topside	
Length	40 meters (45m overall including walkways and WTW platform)
Width	16 meters (30m overall including stairs and walkways)
Height	20 meters (excluding vent tip)

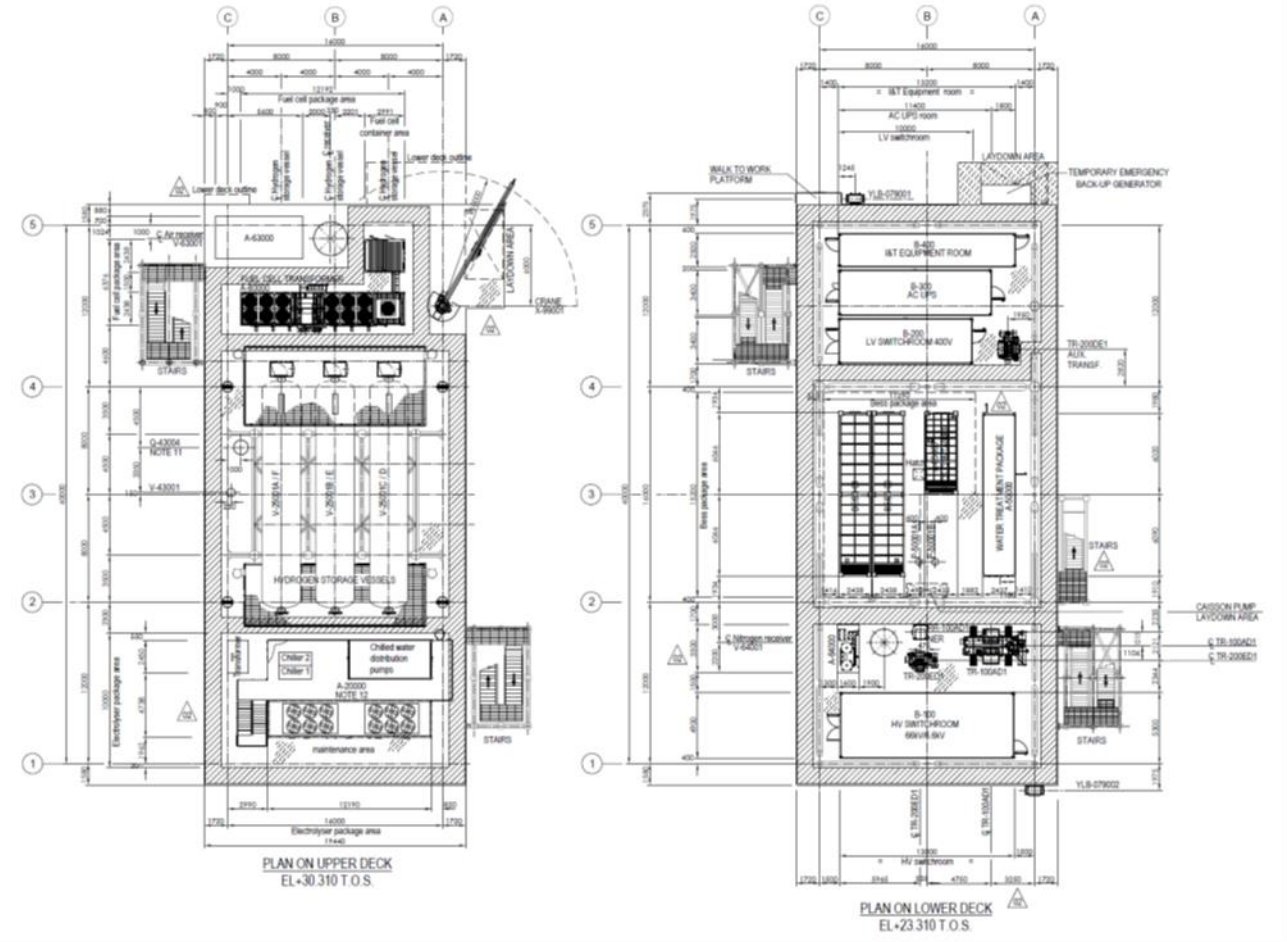


Figure 5.1 - Base Load Power Hub Plot Plan

5.3 MONOPILE-TOPSIDES INTERFACE

The interface level between Monopile and Topsides (comprising TP) is at El.+17.050 m relative to LAT, as per Figure 5.2. The TP will be connected to the monopile in offshore by bolting.

The monopile has been surveyed on 29 May 2023 showing as-built interface connection as reported in Attachment 2.

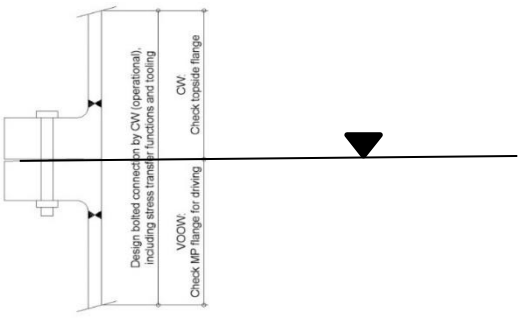


Figure 5.2– Monopile-to-Transition Piece Flange

The TP not-to-exceed weighed weights (excluding rigging) are:

Transition Piece (TP) Lifting	
Expected lifting weight	300 ton (contractual NTE with installation contractor)
CoG shift factor	5% (0.8m radius)
Weight Contingency factor	3% (based on weighing apparatus tolerance)
Transition Piece (TP)	
Length	16 meters (25m overall including stairs)
Width	16 meters (25m overall including stairs)
Height	10 meters

5.4 CAISSON FRAME

Scope of the Installation contractor is to install the Caisson frame, including n.3 caissons (

The Caissons + frame weight (excluding rigging) is: 26 t

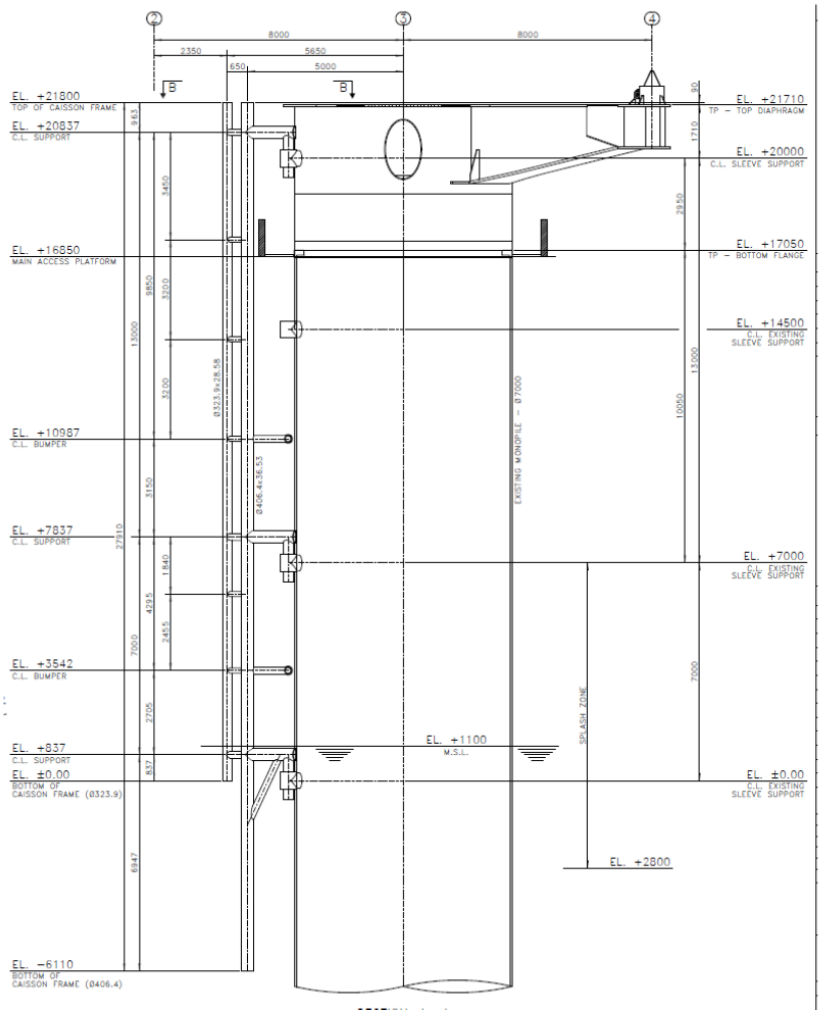


Figure 5.3– Caissons with frame and MAP

The caisson frame not-to-exceed weighed weights (excluding rigging) are:

Caissons and supports	
Expected lift weight	26 ton
CoG shift factor	5% (0.8m radius)
Weight Contingency factor	10% (item class C – DNVGL-ST-N001 – not to be weighed)
Caissons and supports	
Length	30 meters
Width	5 meters
Height	5 meters

6 T&I SUBCONTRACT – GENERAL REQUIREMENTS

Any deviation from this specification shall be approved by RM and, via RM, by CW.

6.1 GENERAL REQUIREMENTS FOR MARINE OPERATIONS

6.1.1 Approval of Installation Subcontractor·

DEME is the Installation Subcontractor selected by RM.

The Installation engineering shall comply with ref. /1/ listed in section 2.1.

6.1.2 Planning of Marine Operations

Marine operations shall be planned and prepared to ensure safe execution of the scope in accordance with the applicable Codes and Standards (see section 2.1)

All foreseeable contingency situations or risk events shall be identified, and contingency plans prepared for these situations. Such plans shall consider redundancy, back-up equipment, emergency procedures, and any other relevant preventative measures and actions.

6.1.3 Vessel Approval

HLV Gulliver or Rambiz is the installation vessel proposed by DEME and approved by RM.

Vessel approval process is as follows:

a) RM provides approval based on a review and endorsement that includes, but is not limited to the following:
   i. Document compliance with the IMO International Safety Management (ISM) Code
   ii. Last 2 years of external ISM Code Audits
   iii. Last 4 years of injuries and illness
   iv. Last 4 years of Port State / Flag State citations
   v. Drug and alcohol policy
   vi. Inspection and maintenance procedures and practice
   vii. Response to Company questions

b) All vessels nominated for project work shall be inspected and approved by CW and MWS during the suitability survey twelve (12) weeks prior to the date scheduled for mobilization. The scope of the inspection will follow the normal MWS inspection format. RM shall furnish the audit findings to CW Project Installation Engineer and MWS for closure.

c) Twelve (12) weeks prior to the date scheduled for mobilization of any vessels the CW and MWS will carry out a complete audit of the subject vessel including an audit of the HSSE/SP management system operating thereon.

d) All vessels nominated by DEME for use on Company projects shall be "In Class" and shall be in compliance with all requirements of the Classification Society under which the vessel is classed, prior to mobilization.

e) Vetting process of Marine spreads. All the offshore spreads shall be positively vetted and accepted by a CW before use. All vessels shall have a valid OCIMF OVID inspection report.

f) Stability

viii. DEME shall demonstrate, via RM, to CW and to MWS satisfaction that all vessels proposed for use on any CW marine operation have sufficient stability and reserve buoyancy under the design conditions.

g) Motions and Performance

ix. Environmental (including wave, wind and current forces) and its effect on the motion of the installation equipment and mooring system during various phases of operation shall be calculated.

x. For operations where accurate prediction of motions is essential for the safe execution of the scope of work, DEME is required to perform such analysis to predict the limiting conditions, and to validate assumptions on the suitability for expected operations. Frequency or time domain techniques shall be used to analyse the relative motions of the vessel.

h) Moorings and Positioning

xi. Dynamically positioned vessels (if applicable) shall comply with IMCA Guidelines for the Design and Operation of Dynamically Positioned Vessels. For DP vessel operations, DEME shall include in the Installation Manual contingency plans to be adopted in case or DP failure.

xii. Any vessels involved in DP operations will have its DP Class vetted.

xiii. Should the vessel be moored, DEME shall submit a detailed mooring arrangement, provide line tensions under all operating conditions, clearances to and over pipelines, mid-line buoys, mooring fixtures, lay and recovery procedures and topography data.

The presence of existing facilities (e.g. platforms, pipelines, etc.) shall be considered and mooring to Company assets shall not be considered without prior RM and, via RM, CW approval. All mooring winches shall have line tension monitors with continuous readout. The readouts shall be mounted locally and have remote readout at any control position. All anchor lines shall be tested for a minimum of 15 minutes to a pre-tension equal to the maximum operating loads to verify the holding capacity of the anchors.

i) Equipment Testing

xiv. DEME shall develop and document test or trial procedures for all equipment required for the intended work and necessary to meet referenced standards and practices. This shall include testing trials programs prior to the start of operations that may be witnessed by CW. CW reserves the right to inspect, survey and approve all project equipment.

xv. Project specific equipment that does not form part of the normal marine equipment shall be calibrated, function tested, and any necessary operator training given, prior to mobilization.

j) Guiding and Position Systems

xvi. Where marine operations require the placement of an object either by or onto a marine vessel, guides and bumpers shall be employed to assist placement of the object. It is not the intent that this requirement applies to small lifts of equipment, or items that can be considered normal cargo handling but more focused on topsides or subsea lifting operations where there is a risk of injury to personnel if manual intervention is required to place the Item. Guides and bumpers shall be designed to allow the item to be installed within the required tolerance but shall have sufficient dimensional scope to ensure there is no risk of the object hanging up on the guides.

k) Inspection and Maintenance

xvii. DEME shalt demonstrate to RM and RM to CW that all vessels proposed for CW marine operations are inspected and maintained in accordance with a systematic and comprehensive inspection and maintenance program. This DEME obligation extends to all sub-contracted vessels and equipment.

xviii. Via RM, CW retains the right to audit DEME maintenance management systems to verify that the inspection, maintenance and repair activities are up to date, deficiencies identified, and a plan for their remediation identified.

6.1.4 Health, Safety, Risk and Quality

A. CW/RM has a primary emphasis on safety and therefore require DEME to have, and effectively implemented, a comprehensive Health and Safety Management Program which meets the requirements of the project specific Safety Coordination Procedures and the International Maritime Organization (IMO) International Safety Management (ISM) Code for vessels.

B. DEME shall prepare a project specific Safety Management Plan to act as the 'bridging document' between the DEME procedures and processes and those of RM and CW. The project specific Safety Management Plan shall be for the DEME operations and those of all its Subcontractors.

6.1.5 Hazop

A. Hazardous Operations Assessments (HAZOP) shall be performed during various phases of the work as required by the project specific Coordination Procedures section under Risk Management.

B. DEME is responsible for organizing the HAZOP process and ensuring that the attendees include personnel from their Project, Operations teams, Subcontractors, RM and CW representatives and outside specialists, as required.

6.1.6 Quality

DEME shall develop and submit to RM for CW approval, a project specific Installation Quality Plan for its operations and those of all sub-contractors. This shall be based on the Principles and Clauses of ISO 9000 and any project specific Quality Coordination Procedure.

6.1.7 Regulatory and Environmental Management

Contractor shall develop, as required by the project specification Coordination Procedures, a Regulatory and Environmental Management Plan. The plan shall Include, but not be limited to waste management and services, including treatment of, or disposal of all offshore trash and waste, environmental monitoring programs, water pollution prevention, spill prevention and response measures and environmental regulatory compliance measures.

6.2 EXECUTION OF MARINE OPERATIONS

DEME shall execute the proposed Marine Operations in accordance with Execution Plans and Procedures agreed and approved by RM and, via RM, by CW.

DEME shall produce the Marine Operation Manual 120 days before the commencement of the operations as a minimum. The Marine Operation Manual shall contain, but not limited to:

a) Operational procedures for the planned operations that reflect characteristics environmental conditions, physical limitations, design assumptions and tolerances

b) Procedures sufficiently detailed to ensure that, if followed, the requirements stated in the engineering studies and specifications will be achieved

c) All the aspects of the operations including mobilization and demobilization.

DEME must ensure that the marine execution is managed and performed in accordance with sound practices, which comply with DEME written procedures, processes, and relevant national and international standards and regulations. The plan shall address, but not be restricted to, the following key areas:

6.2.1 Organization

A. DEME shall develop an organizational structure and define the roles and responsibilities of key personnel involved with the marine operation prior to the execution of any work. Organization charts, including names and functional titles of key personnel shall be developed and included in the Marine Operations Manual. Authority during the operation and Interfaces with Company or other relevant Third-Party bodies shall be clarified. Responsibilities and actions in emergency situations shall be defined.

B. Superintendents shall possess a thorough knowledge and have experience of the entire marine operations; key personnel shall have knowledge and experience within their own area of responsibility. DEME is responsible for ensuring that documentation and procedures are produced in sufficient time to allow time for marine personnel to familiarize themselves with the proposed operation.

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

C. Communication lines with redundancy shall be clearly defined and included in the Marine Operations Manual. A test of the communications shall be performed prior to commencement of the work.

D. DEME shall ensure that sufficient personnel, both marine and project specific crew, are involved in the marine operation to avoid personnel working excessive hours.

E. DEME shall provide qualified medic on board the HLV sufficiently equipped for first aid assistance

6.2.2 Operational and Design Criteria

DEME shall ensure, in planning the execution of Marine Operations, that sufficient time is included for contingency situations.

Restrictions on Operations

DEME shall clearly define, and submit to RM, for RM and CW approval, during the engineering planning phase, any restrictions on operations and shall ensure that approved means are established to monitor the controlling parameters during the operational phase.

Contingencies and Reserves

DEME shall quantify, during the engineering and planning phase, reserves and contingencies between the design and operational limiting conditions. CW required minimum reserves and contingencies shall be defined in the DEME Manual and Installation Plan and in any other procedures related to the specific marine operations being executed.

6.2.3 Weather Management

DEME shall Implement a weather management process in accordance with the requirements of DNV Rules, ref. 1.

6.2.4 Readiness Reviews

A. A Readiness Review meeting, prior to mobilization, shall be held involving the key operations personnel from CW, RM and DEME. This Readiness Review meeting shall be used to confirm that all parties have a clear, mutual understanding of the work and procedures, and are aligned on execution objectives, safety management, incident response and reporting, and emergency preparedness.

B. DEME superintendent shall perform a thorough on-board briefing for the crew, describing the key aspects of the operation, roles and responsibilities and safety expectations. The briefing shall be repeated for all replacement personnel.

6.2.5 Briefings and Job Safety Analysis (JSA)

A. CW requires formal JSAs to be performed for all potentially hazardous operations even if they are routine.

B. Foreman/shift supervisors shall perform briefings at each shift change to discuss the progress during the previous shift, activities to be performed during the next shift, and any other general operation Issues.

C. A JSA shall be performed prior to any potentially hazardous task. The JSA shall identify any risks and ensure that all mitigations have been identified and effected.

6.2.6 Daily Progress Reporting and Progress Meetings

DEME shall submit a Dally Progress Report (DPR) which summarizes the twenty-four hours period for the previous day. The DPR shall specifically define if there are discrepancies with what Is required by the Scope of Work or disagreements with RM (or with CW via RM) about the proper execution of the work. The DPR period shall be from 0000 to 2359 and a copy submitted to RM for submission to CW prior to 16:00 the following day.

The report format, that is already covered in section VII of the contract, will be developed for the specific operation but shall contain as a minimum, a breakdown of key activities that include, but are not limited to the following:

A. Forward Plan - Define critical or key activities for the next twenty-four hours period.

B. Weather - Recorded every six hours including the specific conditions for the vessel on weather standby.

C. Vessel Operating Conditions

D. Critical Equipment Downtime - Down time of critical equipment.

E. Consumables - Fuel and lube consumed, and amounts remaining on board.

F. Support Vessels - All boat activity engaged in loading or back loading goods and equipment

G. Helicopter Operations - Record of operations.

H. Persons on Board -All persons coming on board or departing.

I. Medical - All medical emergencies and injuries requiring medical attention or evacuation shall be recorded.

J. All near misses shall be recorded.

K. Drills, Musters and Safety meetings - Record.

DEME shall hold a Daily Progress Meeting during mobilization and the offshore phase of the work to review the Daily Progress report, safety items, to review progress and upcoming work. The meetings will be chaired by DEME Superintendent and attended by all key personnel. DEME shall prepare Minutes of Meetings.

6.3 MANAGEMENT OF CHANGE

A. All marine operations that deviate from standard procedure shall be controlled by an approved Management of Change (MOC) procedure that will describe the process required to allow deviation from the written and approved procedures and marine operations manuals. DEME shall not change any element of the approved procedures or marine operations manual without completing the requirements of the MOC process. All the MOC change requests shall be approved by RM and MWS, and via RM, by CW.

B. The MOC must consider potential safety and schedule implications as part of the process.

7 SCOPE OF WORK

7.1 GENERAL

DEME scope of work shall consist in the following main activities, described in detail in section 7.5:

- Performing all necessary engineering activities required for a correct execution of the work and in accordance with:
  - This specification (ref Appendix A – Resp. matrix)
  - Marine Warranty Surveyor specific requirements
- Mobilizing the marine spread for safely perform all required offshore operations
- Lifting the TP from the transportation barge
- Stabbing the TP on the existing Monopile top flange and executing the bolted connection
- Lifting the Caisson Frame from the transportation barge
- Stabbing the Caisson frame on the existing TP and Monopile
- Lifting the Topside from the transportation barge
- Stabbing the Topside on the TP and executing the partial pen. welds

Before load out, DEME shall inspect the construction yard and shall ensure and satisfy himself that the structures to be transported and installed offshore are in all respect ready for installation (e.g .sling laying / installation aids/..)

DEME will receive for information all the as-built documentation, including:

- existing MP as built survey;
- dimensional control of TP bottom flange and the 4 legs on top;
- green length cut elevations;
- dimensional control of topside legs;
- installation AIDS.

and notifying in writing RM if any inconsistency is encountered.

RM is responsible for bringing these to the attention of CW and work towards resolving the inconsistencies, interferences etc.

All rigging equipment to be pre-installed will be procured and delivered to the RM yard at least 21 days prior to loadout operation. Before the load-out, RM will install the rigging equipment on yard.

RM is responsible to provide the information for RM to obtain all necessary approvals and authorizations by the appointed Marine Warranty Surveyor prior to LO.

DEME shall provide services, activities or materials related to the Installation scope of work (mobilization of naval means, manpower, tools, consumables, etc.) as necessary for the proper execution according to the Contract.

For the whole duration of the offshore activities, the DEME shall have available a 24h weather forecasting service (Nos 2 independent weather forecasts shall be taken from different weather providers).

RM confirms that the design of the TP and topside are adequately catered for the transportation and installation requirements.

7.2 MANAGEMENT ORGANIZATION

Installation contractor shall provide the following:

- Organization Plan

  Project organization chart with defined roles and responsibilities for each person and the resume of key personnel.

- Coordination and Communication

  Plans and schedule for coordination of all activities, development and approval of plans and procedures, vessels inspections and process for communication of Information within the organization and to the Contractor.

- Document Control

  Process for all relevant documents including Contractor, MWS and Company review and approval.

- Readiness / Risk Assessment Plan

  Process, schedule and documentation necessary to conduct a readiness review and risk assessment sufficiently in advance of operations.

- Permits and Regulatory Approval

  Detailed list and schedule for acquisition of all regulatory and / or permit approvals required by the operation or vessel Flag State and in any Port State where the operation takes place

7.3 TRANSPORTATION (Not applicable to DEME scope)

The platform components are foreseen to be transported from the fabrication yard to the installation site using cargo barge.

Seafastening, towing tug and cargo barge are not DEME scope.

DEME will receive TP, topside and caissons onto the same Cargo barge, under RM responsibility.

The following sections report the standard requirements for approving the transportation naval means and equipment. Only the requirements applicable to BLPH project and consistent with procedures shall be considered.

7.3.1 Hull

A. All Vessels.

- Length, beam, depth and draft for intended work.
- Minimum under keel clearance requirements.

7.3.2 Propulsion Equipment and Control Systems

A. Main Engines, Thrusters and Propellers.

- Main engine and thruster manufacturer rated brake horsepower (BHP).
- Type of propellers and function.

B. Control Systems.

- Propulsion control systems including performance for the intended work.
- Dynamic positioning capability (if fitted) and certification of performance.
- Number and capacity of primary and emergency generators.

C. Towing Vessels

- Certified Bollard Pull Test Results within the last five years

7.3.3 Self-Propelled Vessels Fuel and Lube Oil Systems

- Capacity of fuel and lube oil and vessel range.
- Daily fuel and lube oil consumption for in working and standby mode.

7.3.4 Navigation and Communications Equipment and Systems

- List of all navigation system components by type and capability.
- List of all communications systems components by type and capability.

7.3.5 Ballast Water Systems

- Tanks - Number, location and capacity.
- Pumping Systems Number and capacity.
- Control -Type of ballast control system.

7.3.6 Towing Equipment and Procedures

- Specific data on towing points, towing gear and emergency towing equipment with type, location, strength and method of use/deployment.

- Maintenance procedures, Inspection plans and results use log and retirement criteria for all towing equipment.

7.3.7 Towing Vessels / AHT

- Number, type and capacity of winches and stern rollers.
- Number, type and capacity of tow pins and shark jaws.
- Number, type, size and strength of wire rope, synthetic towing equipment and all related towing gear.
- Maintenance procedures, inspection plans and results use log and retirement crileria for all towing equipment.

7.3.8 Test Reports and Certifications

- Copies of test reports and certifications for vessels and equipment including, but not limited to primary and emergency towing equipment, safety equipment, backup systems, DP systems and all project specific equipment.
- Class and Flag State documentation for compliance with classification, certification, Flag State, Port State and IMO requirements.

7.4 OPERATIONS PLAN

DEME shall develop for RM and, via RM, CW approval an Operations Plan (Plan) that includes but is not limited to:

7.4.1 Transit Route

- Draft of HLV Gulliver or Rambiz and assist vessels at departure port, along the route and at arrival at site.
- Identify any physical or environmental limiting criteria for departure and arrival at site such as bridges, water depth, overhead power lines, locks, wind speed, visibility, etc.
- Provide nautical charts with specific route.
- Local port authority requirements or regulations.
- Mooring arrangement and assisting vessel details, if used.

7.4.2 Met-Ocean

- Vessel capability to perform under the extreme metocean conditions for the specific route and time of year using met-ocean data.
- Define vessel motions, limiting conditions and/or decreased performance.

7.4.3 Mooring / Anchoring Equipment

- Number, location, type and capacities of anchors and anchor gear.
- Number, location, type and capacities of mooring winches
- Number, location and capacity of bitts, cleats, and chocks.
- Number, type, size and strength of mooring wire rope or synthetic lines.

7.4.4 Propulsion Equipment and Control Systems

D. Main Engines, Thrusters and Propellers.

- Main engine and thruster manufacturer rated brake horsepower (BHP).
- Type of propellers and function.

E. Control Systems.

- Propulsion control systems including performance for the intended work.
- Number and capacity of primary and emergency generators.

F. Towing Vessels

- Certified Bollard Pull Test Results within the last five years

7.4.5 Self-Propelled Vessels Fuel and Lube Oil Systems

- Capacity of fuel and lube oil and vessel range.
- Daily fuel and lube oil consumption for in working and standby mode.

7.4.6 Navigation and Communications Equipment and Systems

- List of all navigation system components by type and capability.
- List of all communications systems components by type and capability.

7.4.7 Ballast Water Systems

- Tanks - Number, location and capacity.
- Pumping Systems Number and capacity.
- Control -Type of ballast control system.

7.4.8 Towing Equipment and Procedures

- Specific data on towing points, towing gear and emergency towing equipment with type, location, strength and method of use/deployment.
- Maintenance procedures, Inspection plans and results use log and retirement criteria for all towing equipment.

7.4.9 Towing Vessels / AHT

- Number, type and capacity of winches and stern rollers.
- Number, type and capacity of tow pins and shark jaws.
- Number, type, size and strength of wire rope, synthetic towing equipment and all related towing gear.
- Maintenance procedures, inspection plans and results use log and retirement crileria for all towing equipment.

7.4.10 Test Reports and Certifications

- Copies of test reports and certifications for vessels and equipment including, but not limited to primary and emergency towing equipment, safety equipment, backup systems, DP systems and all project specific equipment.
- Class and Flag State documentation for compliance with classification, certification, Flag State, Port State and IMO requirements.

7.4.11 Procedures (valid for transportation and installation)

The Plan shall include a comprehensive set of project specific procedures that fully describe the methods to be employed, including step by step accounts or narratives of each phase of the work. The procedures shall include drawings, diagrams and schematics that clearly describe the work and for the specific type and area of operation.

The procedures shall include, but not be limited to:

A. Emergency Response / Incident Notification/Orientation Plan

- Vessel Emergency Response Plan and use of bridging documents to Company, other vessels or contractors.
- Incident reporting and near miss process.
- Operations safety plan and management.
- Use of personal protective equipment.
- Job safety analysis plan.
- Pre-departure and pre-arrival safety meeting and check list(s).

B. Weather Management Plan

- Forecasting, monitoring, routing services.
- Environmental factors and limiting criteria.

C. Mobilization - Demobilization - Logistics

- Vessel schedules.

- Provisioning and support logistics.

D. Contingency

- Main engine failure.
- Abandon ship.
- Fire.
- Medical emergency.
- Adverse weather conditions.
- Collision or rescue vessel operations.
- Tow wire failure.

E. Security Plan:

- Define Designated Security Officer.
- Provide copy of Integrated Security Management System.
- Provide copy of Security Incident Reporting System.
- Document compliance with IMO Resolution A.924 (22) and IMO MSC I Circular 622 and 623.
- Provide format for conducting threat analysis for piracy and terrorist.
- Define physical security procedures.

F. Towing Operations (if and where applicable to DEME scope)

- Location, connection, capability and operation of each towing vessel.
- Location, connection, capability and operation of all assist vessels.
- Calculation of towing characteristics and towing tug requirements including required bollard pull versus towed barge resistance for the route specific met-ocean conditions and time of year.
- Unmanned Tows
- Equipment and operation of navigation lights.
- Towing Tug Catenary: Calculation of expected catenary during towing operations.
- Tow Line Handling Procedures: Procedures to handing off and retrieving tow lines between towing vessel during refuelling or re-supply operations.

G. Refuelling / Resupply Plan

- Locations.
- Procedures / Pollution Prevention.
- Cargo / equipment handling plan and equipment certifications.

H. Vessel Daily Report

Transportation contractor shall provide RM and CW with daily operations report that is transmitted electronically and contains a minimum of the following.

- Vessel position and course.
- Average speed to date and speed last 24 hours.
- Distance for voyage, last 24 hours and to go.
- ETA for arrival port and any intermediate ports (re-fuelling, etc.).
- Wind speed and direction.
- Sea state (sea and swell direction and height)
- Presence of ice and visibility.
- Roll/ pitch of vessel and any towed vessel.
- Fuel consumed last 24 hours and remaining on board.
- Incidents / injuries.

7.4.12 Engineering

RM shall plan and execute all engineering studies necessary to meet the transport requirements.

The relevant reports and drawings shall be submitted to MWS for approval.

The engineering shall include, but not be limited to:

- Preliminary Barge layout
- The final barge layout will be issued by RM and approved by DEME and MWS
- Ballast plan for towing
- Barge(s) stability calculation in intact and damaged condition
- Barge(s) longitudinal strength check
- Minimum bollard pull calculation
- Barge(s) structure check for the loads applied by lower grillage and seafastening.
- Towing manual including detail about the selected route and verification that all towing line components and relevant connections are suitable for the towing
- Towing line drawing

7.4.13 Installation Vessel Mobilization

DEME is responsible to mobilize the HLV Gulliver or Rambiz in due time.

DEME shall deliver to RM yard all rigging and equipment to be pre-installed on TP , caissons and Topside at least 21 days in advance before loadout operations.

A detailed delivery schedule will be agreed after Contract award.

7.5 TP, CAISSONS AND TOPSIDE INSTALLATION

DEME is responsible to perform the agreed Engineering studies and to mobilize a marine spread suitable to successfully perform the installation of BLPH transition piece, Caissons frame and Topside.

All the items are planned to be installed in the same offshore installation campaign in a congested area with solar panel platform and infield cables.

7.5.1 Installation Plan

DEME shall develop an installation plan for RM and, via RM, CW & MWS approval.

The installation plan shall include, but not limited to:

7.5.1.1 Design and Engineering Review

DEME shall review the detail design documents and all the analyses related to the installation. The requirement is applied but not limited to the following:

a) Detail Engineering Phase:

- Lifting analyses (TP, caissons and topside)
- Design weather criteria
- Installation guides and associated steel work.
- Weight control reports
- Barge layout and seafastening
- Review the check list for the inspection to be carried out at construction yard before load-out and transportation. The check list shall be signed by DEME, MWS, RM.

b) Review of detail design drawings with special attention to Fabrication Phase:

- items weight control report, track weight growth, center of gravity and resulting offsets between the hook position and the final center of gravity.
- lift points configurations and slings layouts.
- as built survey of the bottom flange of TP
- as built survey of the installation AIDS
- cut line of the green length on TP
- dimensional cross checks
- Review of the drawings of scaffolding required for seafastening cutting

c) Installation site:

- Site survey data, charts, survey notations and baselines.
- Met-ocean criteria versus operability for the installation means proposed.

- solar Panel platform respect areas
- infield cables respect area (for anchoring purpose)
- details which can impact installation (e.g. existing ladder top section see section 7.5.2)

7.5.1.2 Installation Engineering Design

DEME shall perform engineering design and other relevant work necessary to complete the installations as defined in the Scope of Work and per Contact and shall prepare the 'Installation Manual' and the engineering documents as defined below. The detailed Installation Engineering and Design shall be based on DNV Rules, ref. 1. The design method and number of load cases for each sequence of the installation is to be approved by RM and, via RM by CW and MWS.

DEME shall plan and execute all engineering necessary to meet the installation requirements.

All assumptions, methodology and tools used in the studies shall be presented to RM and, via RM, to CW in the form of DEME Basis of Design to be approved by RM and, via RM, by MWS and CW prior DEME commencing the work.

The installation engineering shall include, but not be limited to:

- Concept design of installation aids
- Mooring analyses and sequence
- Motion analysis based on weather limitations (calculation of the crane tip vertical motion amplitude shall be calculated and compared with design conditions – section 16.7.3 Ref. 1)
- Module movement – section 16.14.2 ref. Ref. 1 and motion analysis
- Selection of all lifting slings, shackles and any other lifting equipment supported by proper calculations
- Lifting arrangement detail drawings and reports.
- All studies, analyses and procedures deemed necessary for the installation
- Prepare the Installation Manual including data, procedures, reports and drawings. The Installation Manual shall address all installation issues including HSE, Risk Assessment and Contingencies.

7.5.1.3 Engineering Documents

Based on the above DEME shall prepare an Engineering Manual that contains the detail results of the design and analysis activities. The manual shall contain all the scope of engineering documents mentioned in this specification, including, but not limited to:

A. Cranes:

1. Radius and load curves vs. sea state including weather operating limits.

2. Hook ratings, hook travel and speed.

B. Mooring:

1. Mooring analysis including details of all mooring fixtures

2. Rated capacities of all components and diagrams of midline buoys and pipeline protection at crossing.

C. Rigging:

1. DEME criteria for rigging and general lifting (containerized supply) for loads up to 35 MT, onshore and offshore.

2. DEME criteria for lifting for loads in excess of 35 tonnes onshore and offshore.

D. Installation Aids concept design:

1. Fixing of installation aids such as padeyes, rigging platform and all other aids requested for design as part of this specification.

E. Welding procedures to be approved by RM and, via RM, by CW.

F. Bolting procedure to be approved by RM and, via RM, by CW.

7.5.1.4 Operations

DEME shall develop an Installation Manual that contains the methods and procedures by which the DEME and his Subcontractors shall perform the installation work. There shall be no changes to the installation procedures without adherence to the requirements set forth in the Management of Change. DEME standard operating procedures together with the design/engineering basis shall provide the input for the installation procedures.

The procedures for each aspect of the installation operation shall be outlined in a step-by-step manner and will include the latest edition of all relevant field related charts showing pipelines and subsea equipment.

The weather / metocean forecast procedure shall be in accordance with Weather Forecast Level A2 as defined in the DNVGL-ST-N001 "Marine Operations and Marine Warranty", Ref.1.

The forecasting services to be used shall be subject to Company approval. Forecasts for the installation operation shall start at least 48 hours before the time of arrival at the installation site with updates every 12 hours thereafter from 2 independent sources.

The installation manual shall include drawings and diagrams as necessary, and include the following, but not limited to:

A. Readiness reviews.

B. Contingency and emergency drawings.

C. Diagrams and Schematics.

D. Logistics and General Support

E. Communication

7.5.2 TP installation

The TP offshore lifting and installation sequence shall be detailed in the installation manual.

A general sequence can be as follows:

- Connect the lifting slings preinstalled on TP to the crane main hook.
- Connect the tugger lines to the TP structure.
- Cut all sea-fastening.
- Upon completion of the sea fastenings cutting, the lifting slings shall be tensioned and any slack in the tugger lines recovered.
- The crane shall then lift the TP module to create a minimum 3.0 m clearance above the grillage
- Cargo barge towed away from HLV bow
- HLV is moved in way that the TP is above the MP aligned with the flange.
- The TP is lowered in final position over the existing flange guided by installation AIDS.
- Orientation will be guided by external painted marking

During lifting operations, the following parameters shall be monitored and reported in the as-built dossier:

- Hook load in all the operation steps (lift-off, movement and set down);
- Environmental conditions during the operation
- Position and orientation of the crane vessel

The TP Lifting analysis report in Ref. [22] is issued by RM as part of the detail design package.

Notes:

a) lift points shall not be cut and removed.

b) TP shall be transported with bolts preinstalled (not protruding from the bottom)

c) Prior to Transition Piece (TP) installation the top section of the ladder needs to be removed (bolted section – see image below). After removal, a temporary SRL (self-retracting lanyard) support is required. Final SRL support will be from the Transition Piece girder.



Figure 7.1– Existing ladder on MP – Permanent SRL



Figure 7.2– Existing ladder on MP

7.5.2.1 Bolting

The connection between MP and TP is done by bolting. All the bolts will be preinstalled inside the TP bottom flange. Stud bars are 64mm in dia. and 156 in number.

Personnel will access the TP internal flange after TP set down on Monopile.

7.5.2.2 Leg Green

Based on the offshore survey results (Attachment 2) and as-built surveys of the completed topside and TP, green leg lengths will be cut and prepared (bevel) in yard prior to loadout.

Only partial penetration welds are required to be performed offshore.

The TP will be fabricated to best suit the installed monopile inclination. .

7.5.3 Caisson installation

The Caisson frame offshore lifting and installation sequence shall be detailed in the installation manual.

In general, the sequence can be as follows:

- Connect the lifting slings preinstalled on caisson frame to the crane AUX hook.
- Connect the tugger lines to the caisson structure.
- Cut all sea-fastening.
- Upon completion of the sea fastenings cutting, the lifting slings shall be tensioned and any slack in the tugger lines recovered.
- The crane shall then lift the caisson frame to create a minimum 3.0 m clearance above the grillage
- Cargo barge towed away from HLV bow
- HLV is moved in way that the caisson frame is above the MP aligned with the caisson frame sleeves.
- The caisson frame is lowered in final position guided by installation AIDS.

Note: Caisson frame installation shall be blind installation according to approach direction of HLV with the respect of solar panel safety area.

Considering lifting operation will be performed with crawler crane present on deck of HLV, the engagement phase of caisson frame pins into the sleeves will be monitored by personnel present on TP (safe area protected by TP structure).

7.5.4 Topside Installation

The topside offshore lifting and installation sequence shall be detailed in the installation manual.

In general, as preliminary presented, the sequence can be as follows:

- Connect the lifting slings to the crane main hooks through spreader beams.
- Connect the tugger lines to the topside structure.
- Cut all sea-fastening.
- Upon completion of the sea fastenings cutting, the lifting slings shall be tensioned and any slack in the tugger lines recovered.

- The crane shall then lift the topside module to create a minimum 3.0 m clearance above the grillage
- Cargo barge towed away from HLV bow
- HLV is moved in way that the topside is above the TP with the legs aligned with the TP receiving legs.
- The module is lowered in final position entering the stabbing cones.
- De-rigging operation without damaging the topside

During lifting operations, the following parameters shall be monitored and reported in the as-built dossier:

- Hook load in all the operation steps (lift-off, movement and set down);
- Environmental conditions during the operation
- Position and orientation of the crane vessel

The Topside Lifting analysis report in Ref. [18] is issued by RM as part of the detail design package.

Note: lift points shall not be cut and removed.

7.5.4.1 Welding and NDE

DEME shall perform all field welding in accordance with the welding procedures approved by RM and, via RM, by CW and MWS.

All weld NDE shall be performed according to an NDE plan prepared by DEME and approved by RM and, via RM, by CW/MWS.

Offshore welding will be based on the following:

1 - Bevel angle of 45° for deck to TP legs welding with partial weld.

2 - Cooling time of 12 hours before NDT is performed.

3 - A root opening of 3-5mm.

7.5.5 Marine Spread and Installation Equipment

DEME shall provide:

- A Heavy Lift Vessel with all equipment and personnel to execute the items installation in 1 offshore campaign.
- Slings, shackles, link plates, spreader beams and rigging for all the items to be installed.
- HLV shall be equipped with bolting and welding crew and required tools.
- HLV shall be equipped with observation ROV to be used in case of dropped object during installation.

All equipment and tools shall be made available at the construction yard or at the offshore site according to the operation plan.

7.5.6 Completion Works

Items that are assumed to be part of the completion activities and planned to be performed during the waiting time for NDT are included here after but not limited to:

- NDE of welds;
- Removal of rigging/access platform (if applicable);
- Removal of all temporary works and auxiliary structures (e.g. bumpers and guides);
- Lift on, lift off, of miscellaneous small items not exceeding 25 t each and limited to 5 lifts)
- Grinding smooth sea-fastening remains after installations, 25mm from the parent material (only if applicable and accessible above the splash zone);
- Installation and weld securing of ship loose items, if applicable;
- Install all handrails and gratings shipped loose or reinstate the ones temporary removed.
- Topside level survey report.
- Removal of any debris dropped by DEME on the seabed and/or on installed components prior to leaving of the offshore location.
- Final seabed survey by ROV

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8 MARINE WARRANTY SURVEYOR

CW will nominate a Marine Warranty Surveyor (MWS), who will be in charge of reviewing, approving and supervising all aspects of the transportation and installation.

MWS scope of work shall include as a minimum:

- MWS will review and approve the list of key planning, engineering and execution deliverables as the principle means of quality verification.
- No vessel or item of equipment shall be used on CW marine operations until the warranty survey has been completed and all remedial actions closed out to the satisfaction of the MWS and CW. The warranty survey, to be attended by RM, MWS and CW, has to be scheduled minimum 3 months before offshore execution.
- The use of MWS to confirm vessel suitability does not release DEME from its obligation to ensure that all equipment nominated for use on CW's project is suitable for its intended use and complies with all CW and regulatory requirements.
- Inspection of vessels, barges, tugs and marine equipment to certify the suitability for the required SOW.
- Review and approval of all engineering documents relevant to loadout, seafastening, transportation, lifting and installation.
- Release the certificates allowing the execution of loadout, sail away, towing and offshore operations; without which marine operations cannot commence.
- Follow-up all operations verifying that are performed according to the approved procedures.
- Review and approve request of deviation from the approved operating procedure. The request of deviation shall be submitted only though an approved management of changes procedure.

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

9 REQUIRED DOCUMENTATION

9.1 DOCUMENTS TO BE PROVIDED AFTER CONTRACT AWARD

Within the terms established at the kick-off meeting, DEME shall issue the Installation Manuals and all other studies, procedures, analyses, reports and drawings showing in detail how he intends to perform the work.

DEME shall perform all required engineering studies, calculations, and analyses to verify that the planned marine operation is in accordance with the Company requirements.

All assumptions, methodology and tools used in these studies shall be approved by RM and, via RM, CW prior to DEME commencing the work.

The results of the Engineering Studies shall be submitted to RM and, via RM, to CW for approval.

The Installation Manual shall contain at least the following information:

- Scope of work.
- Work program.
- List of activities to be carried out at construction yard and timing.
- Position of all naval means in all installation phases.
- Mooring line layout.
- ROV operation (if required).
- Seafastening removal
- Ballast / trimming of HLV for up-ending and lifting operations.
- Lifting and Installation procedures.
- Contingencies and emergencies procedures.
- Removal of temporary steelwork and scaffolding.
- Quality control plan.
- WPS, PQR and NDT plan.
- Certificates of marine spread and equipment.
- NDE procedure, welder qualifications, NDE operator qualifications

Installation Manual shall be in sufficient detail to ensure that, if followed, the requirements stated in the engineering studies and specifications will be achieved.

All documents will be submitted for RM and, via RM, for CW approval at least 120 days prior to the commencement of operations in PDF format.

Documents will be transferred to RM according to Document control procedure (e.g. transmittal supporting documents uploaded on RM sharepoint).

9.2 DOCUMENTS TO BE PROVIDED AT THE END OF THE WORK

All documents issued during the work shall be filed by DEME for at least 5 years.

During this time, they shall always be available at RM and, via RM, at CW request.

Within 30 days from the end of the activities, DEME shall issue the close-out report containing as a minimum:

- Topside installation report, containing the recorded data of the weight of the lifted structures.
- topside level survey report
- Post-installation underwater ROV video report
- All the management approved changes, planning, schedules, and operations as defined in the project specific Coordination Procedures
- QA/QC dossier, including dimensional control and NDT reports, non-conformities, site queries, etc.

Attachment 1 – Responsibility Matrix

ROSETTI MARINO

DEME –EPC CONTRACTOR RESPONSIBILITY MATRIX

BLPH INSTALLATION (TP+CAISSONS+TOPSIDE)

Definitions	
RM	Rosetti Marino
DEME	Installation Contractor
CRW	Client
MWS	Marine Warranty Surveyor

Item	Description	Conceptual Design	Detail Design	Review	Procurement Supply	Onshore activity	Offshore activity	Notes
1	Structural detail design of BLPH including: – Load out structural analysis – Transportation structural analysis – Lifting structural analysis – Transportation fatigue analysis	-	RM	CRW	-	-	-	
2	Load-out procedures / Load-out manuals	RM	RM	MWS	-	RM	-	
3	Load-out upper & lower grillages	RM	RM	MWS / CRW	RM	RM		DEME for information
4	Transportation barge delivery	RM	RM	DEME / MWS / CRW	RM		RM	
6	Transportation barge layout (including Safe grillage and sea-fastening cutting and removal facilities	DEME / RM	RM	DEME / MWS / CRW	-	-	DEME	DEME for sea-fastening off-shore cutting
7	Grillage and sea-fastening design	RM	RM	DEME / MWS / CRW	RM	RM	-	

ROSETTI MARINO

DEME –EPC CONTRACTOR RESPONSIBILITY MATRIX

Item	Description	Conceptual Design	Detail Design	Review	Procurement Supply	Onshore activity	Offshore activity	Notes
8	Barge stability check / Transport motion analysis / Towing Manual	RM	RM	MWS / CRW	-	-	-	
9	Barge structural integrity check for transportation loads	RM	RM	MWS / CRW	-	-	-	
10	TP lifting procedure	DEME	DEME	RM / MWS / CRW	DEME		DEME	Part of OIM
11	TP lifting pad-eyes/Trunnions	DEME / RM	RM	DEME / MWS / CRW	RM	RM	-	
12	TP stabbing (Primary + secondary)	DEME / RM	RM	DEME / MWS	RM	RM	-	CRW for information
13	TP rigging	DEME	DEME	RM / MWS	DEME	RM(1)	-	CRW for information
14	TP installation aids	DEME / RM	RM	DEME / MWS	RM	RM		Linked to point 12.
15	TP completion work – Rigging Removal and loose items lift on/off	DEME	DEME	MWS / RM	-	-	DEME	
16	TP completion work – Bolting of TP to MP foundation	DEME / RM	RM	DEME / MWS / CRW	RM		DEME	Bolts to be preinstalled on TP
17	Caissons lifting procedure	DEME	DEME	RM / MWS / CRW	DEME		DEME	Part of OIM
18	Caissons lifting pad-eye	DEME / RM	RM	DEME / MWS / CRW	RM	RM	-	
19	Caissons stabbing (Primary + secondary)	DEME / RM	RM	DEME / MWS	RM	RM	-	CRW for information

ROSETTI MARINO

DEME –EPC CONTRACTOR RESPONSIBILITY MATRIX

Item	Description	Conceptual Design	Detail Design	Review	Procurement Supply	Onshore activity	Offshore activity	Notes
20	Caissons rigging	DEME	DEME	RM / MWS	DEME	RM(1)	-	CRW for information
21	Caissons installation aids	DEME / RM	RM	DEME / MWS	RM	RM		Linked to point 19
22	Caissons completion work – Rigging Removal	DEME	DEME	MWS / RM	-	-	DEME	
23	TOPSIDE lifting procedure	DEME	DEME	RM / MWS / CRW	DEME		DEME	Part of OIM
24	TOPSIDE lifting pad-eyes/Trunnions	DEME / RM	RM	DEME / MWS / CRW	RM	RM	-	
25	TOPSIDE stabbing (Primary + secondary)	DEME / RM	RM	DEME / MWS	RM	RM	-	CRW for information
26	TOPSIDE rigging including Lifting beam	DEME	DEME	RM / MWS	DEME	RM(1)(2)	-	CRW for information
27	TOPSIDE installation aids	DEME / RM	RM	DEME / MWS	RM	RM		
28	TOPSIDE completion work – Rigging Removal and loose items lift on/off	DEME	DEME	MWS / RM	-	-	DEME	
29	TOPSIDE completion work – welding and NDE of Topside to TP	DEME / RM	RM	DEME / MWS / CRW	DEME		DEME	

Notes:
(1): Rigging to be delivered in RM yard at least 1 months prior to Loadout activities
(2): RM shall install the lower rigging in yard prior to Loadout on top of Topside. Lifting beam with upper rigging to be ready on board of installation vessel.

Attachment 2 – Foundation As-built survey

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Title document:

Foundation As-built Survey CW70 HNA6

Contractor:

Van Oord Offshore Wind b.v.

Employer:

CrossWind C.V.

Project Name:

Hollandse Kust Noord

Project Number:

144671

Document Number:

144671-VOOW-GEN-SUR-REP-0074

0	Issued for Approval	29-05-2023	Ian Coulter	Carlos Figueiredo Do O	Frank Mettbach
Revision	**Description**	**Revision Date**	**Originator**	**Checked**	**Approved**

Revision history

Revision	Purpose of Issue*	Remark/Description	Revision Date
0	3	Issued for Approval	29-05-2023

**Purpose of Issue: Category 1 Issued Information; Category 2: Issued for Review; Category 3: Issued for Approval*

CROSSWIND

Van Oord
Marine ingenuity

144671 Hollandse Kust Noord
Flange measurement ovality
Inspection and Test Record

Rev.: 0
As Built Date: 29-05-2023
Foundation: **CW70 HNA6**

Inspection(s) & Test(s) as per ITP 144671-VOOW-TF-INS-MS-0013 Foundation As-built Survey

No.	Direction [°]	Boltholes	Distance [mm]
1	0 - 180	1 - 79	6680.7
2	45 - 225	20 - 98	6679.3
3	90 - 270	40 - 118	6680.0
4	135 - 315	60 -138	6679.0

Description	Tolerance	Design	As-built	Δ design
Single measurement BCD Max. [mm]	+/- 3.0	6681.0	6680.7	0.3
Single measurement BCD Min. [mm]			6679.0	2.0
Flange Ovality [mm]	≤ 5.0	0.0	1.7	1.7

Comment(s):

Revision Number	Date	Revision Reasoning
0	29 May 2023	For Approval

	Approved by Surveyor	Approved by OCM	Witnessed by Client Representative
Date:	29-05-2023	29-05-2023	29-05-2023
Name:	Ian Coulter	Carlos Figueiredo Do O	Frank Mettbach
Signature:			

CROSSWIND

Van Oord
Marine ingenuity

144671 Hollandse Kust Noord
Flange measurement inclination
Inspection and Test Record

Rev.: 0
As Built Date: 29-05-2023
Foundation: **CW70 HNA6**

Inspection(s) & Test(s) as per ITP 144671-VOOW-TF-INS-MS-0013 Foundation As-built Survey

No.	Direction [°]	Bolthole	Level reading [mm]
1	0	1	47.0
2	45	20	45.0
3	90	40	44.0
4	135	60	45.5
5	180	79	46.5
6	225	98	49.0
7	270	118	49.0
8	315	138	48.0

Description	Tolerance	Design	As-built	Δ design
Flange (Inclination) [°]	<= 0.25	0.00	0.04	-0.04
Flange inclination heading referenced to True North [°] (Heading towards lowest point)			269	

Comment(s):

Revision Number	Date	Revision Reasoning
0	29 May 2023	For Approval

	Approved by Surveyor	Approved by OCM	Witnessed by Client Representative
Date:	29-05-2023	29-05-2023	29-05-2023
Name:	Ian Coulter	Carlos Figueiredo Do O	Frank Mettbach
Signature:			

CROSSWIND

Van Oord
Marine ingenuity

144671 Hollandse Kust Noord
MP measurement position and heading
Inspection and Test Record

Rev.: 0
Survey Date: 29-05-2023
Foundation: **CW70 HNA6**

Inspection(s) & Test(s) as per ITP 144671-VOOW-TF-INS-MS-0013 Foundation As-built Survey

Description	Tolerance	Design	As-built	Δ design
Easting [m ETRS89 UTM31 N]	± 0.50	590719.10	590718.95	0.15
Northing [m ETRS89 UTM31 N]	± 0.50	5841602.30	5841602.42	-0.12
Top of Flange Level [m NL LAT 2018]	± 0.10	17.05	17.09	-0.04
Flange heading referenced to True North [°]	± 5.00	0.00	-2.25	2.25

Comment(s):

Revision Number	Date	Revision Reasoning
0	29 May 2023	For Approval

	Approved by Surveyor	Approved by OCM	Witnessed by Client Representative
Date:	29-05-2023	29-05-2023	29-05-2023
Name:	Ian Coulter	Carlos Figueiredo Do O	Frank Mettbach
Signature:			

CROSSWIND

Van Oord
Marine ingenuity

144671 Hollandse Kust Noord
Flange measurement flatness and angular displacement
Inspection and Test Record

Rev.: 0
As Built Date: 29-05-2023
Foundation: **CW70 HNA6**

Inspection(s) & Test(s) as per ITP 144671-VOOW-TF-INS-MS-0013 Foundation As-built Survey

[°]	Inner Diameter [mm]	Outer Diameter [mm]	Flange Angular Displacement [mm]	Local Flatness Outer Diameter [mm]
0.0	-5.35	0.59	-5.94	0.50
7.5	-5.10	0.69	-5.79	0.39
15.0	-5.05	0.82	-5.87	0.36
22.5	-4.94	0.87	-5.81	0.33
30.0	-4.93	0.95	-5.88	0.23
37.5	-4.92	1.02	-5.94	0.21
45.0	-4.88	1.05	-5.93	0.13
52.5	-4.93	1.08	-6.01	0.09
60.0	-4.86	1.04	-5.90	0.12
67.5	-4.92	0.99	-5.91	0.19
75.0	-4.94	0.96	-5.90	0.18
82.5	-4.92	0.89	-5.81	0.19
90.0	-5.04	0.86	-5.90	0.19
97.5	-5.04	0.80	-5.84	0.18
105.0	-5.10	0.77	-5.87	0.20
112.5	-5.04	0.71	-5.75	0.29
120.0	-5.11	0.66	-5.77	0.41
127.5	-5.13	0.51	-5.64	0.38
135.0	-5.18	0.36	-5.54	0.49
142.5	-5.27	0.33	-5.60	0.44
150.0	-5.36	0.17	-5.53	0.36
157.5	-5.36	0.07	-5.43	0.33
165.0	-5.34	0.00	-5.34	0.17
172.5	-5.40	0.13	-5.53	0.28

[°]	Inner Diameter [mm]	Outer Diameter [mm]	Flange Angular Displacement [mm]	Local Flatness Outer Diameter [mm]
180.0	-5.41	0.17	-5.58	0.41
187.5	-5.32	0.28	-5.60	0.46
195.0	-5.29	0.41	-5.70	0.61
202.5	-5.21	0.59	-5.80	0.66
210.0	-5.15	0.78	-5.93	0.57
217.5	-5.04	0.94	-5.98	0.49
225.0	-4.96	0.98	-5.94	0.30
232.5	-4.80	1.08	-5.88	0.14
240.0	-4.79	0.99	-5.78	0.13
247.5	-4.85	1.00	-5.85	0.17
255.0	-4.81	0.95	-5.76	0.22
262.5	-4.88	0.91	-5.79	0.44
270.0	-5.06	0.78	-5.84	0.59
277.5	-5.26	0.56	-5.82	0.65
285.0	-5.40	0.36	-5.76	0.61
292.5	-5.51	0.26	-5.77	0.50
300.0	-5.60	0.17	-5.77	0.36
307.5	-5.64	0.06	-5.70	0.26
315.0	-5.69	0.00	-5.69	0.17
322.5	-5.71	0.06	-5.77	0.23
330.0	-5.58	0.11	-5.69	0.32
337.5	-5.54	0.23	-5.77	0.42
345.0	-5.47	0.32	-5.79	0.48
352.5	-5.41	0.48	-5.89	0.46

Description	Tolerance	Design	As-Built	Δ design
Flange Angular Displacement max. [mm]	2.5	-4.0	-5.3	-1.3
Flange Angular Displacement min. [mm]	2.5	-6.5	-6.0	0.5
Overall Flange Flatness Outer Flange [mm]	≤ 2.5	0.0	1.1	-1.1

Comment(s):

Revision Number	Date	Revision Reasoning
0	29 May 2023	For Approval

	Approved by Surveyor	Approved by OCM	Witnessed by Client Representative
Date:	29-05-2023	29-05-2023	29-05-2023
Name:	Ian Coulter	Carlos Figueiredo Do O	Frank Mettbach
Signature:			

Attachment 3 – Field information

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

Name	Easting X [m]	Northing Y [m]	Bathy-2017	BEB2023	HSBL2023	LSBL2023	HSBL2048	LSBL2048
OSS	587410.1	5839436.2	-23.68	-23.74	-23.31	-24.10	-22.80	-24.10
CW01 (HNJ6)	577388.7	5833120.6	-25.60	-25.93	-25.12	-26.47	-24.55	-26.73
CW02 (HNJ5)	577717.7	5833954.8	-25.19	-25.56	-24.81	-25.99	-24.81	-26.55
CW03 (HNK6)	578399.4	5833213.4	-24.62	-24.81	-24.23	-25.39	-24.22	-25.44
CW04 (HNI6)	578046.6	5834789.0	-25.12	-25.50	-24.71	-25.95	-24.71	-26.46
CW05 (HNK5)	579410.2	5833306.1	-23.22	-23.34	-22.48	-24.01	-22.48	-24.19
CW06 (HNI5)	578375.6	5835623.2	-25.61	-25.81	-25.18	-26.32	-25.18	-26.46
CW07 (HNK4)	580608.8	5833845.2	-25.32	-25.59	-24.88	-26.04	-24.67	-26.29
CW08 (HNI4)	578704.6	5836457.4	-25.15	-25.30	-24.75	-25.84	-24.75	-25.95
CW09 (HNJ4)	580472.7	5835080.7	-24.22	-24.44	-23.82	-24.82	-23.82	-24.87
CW10 (HNJ3)	580404.8	5836252.6	-24.57	-24.75	-24.20	-25.10	-24.14	-25.10
CW11 (HNK3)	582402.1	5834762.2	-22.31	-22.59	-21.90	-22.92	-21.89	-22.96
CW12 (HNI3)	579464.0	5838382.6	-24.82	-25.07	-24.52	-25.42	-24.52	-25.52
CW13 (HNL6)	583523.7	5833812.7	-20.64	-20.85	-20.27	-21.20	-20.21	-21.21
CW14 (HNJ2)	582116.0	5836050.8	-23.25	-23.38	-22.90	-23.74	-22.84	-23.74
CW15 (HNH6)	579796.3	5839224.7	-24.67	-24.79	-24.28	-25.15	-24.21	-25.15
CW16 (HNL5)	584631.4	5833949.5	-24.77	-24.91	-24.34	-25.33	-24.34	-25.44
CW17 (HNI2)	581278.1	5838405.8	-24.24	-24.30	-23.86	-24.78	-23.84	-24.78
CW18 (HNH5)	580128.5	5840066.7	-24.25	-24.43	-23.89	-24.77	-23.74	-24.78
CW19 (HNK2)	583848.7	5835843.8	-21.27	-21.44	-20.83	-21.80	-20.79	-21.84
CW20 (HNL4)	585761.3	5834065.2	-24.59	-24.80	-24.18	-25.19	-24.17	-25.25
CW21 (HNH4)	580532.4	5840873.3	-23.94	-24.05	-23.63	-24.48	-23.63	-24.59
CW22 (HNH1)	582906.8	5838216.8	-23.07	-23.22	-22.71	-23.60	-22.67	-23.60
CW23 (HNH2)	581926.1	5839989.9	-23.98	-24.07	-23.60	-24.49	-23.59	-24.53
CW24 (HNL1)	585553.8	5835642.7	-24.64	-24.76	-24.18	-25.16	-24.12	-25.16
CW25 (HNL3)	586883.6	5834139.2	-23.27	-23.46	-22.83	-23.99	-22.83	-24.08
CW26 (HNH3)	581063.2	5841610.0	-23.71	-23.96	-23.44	-24.31	-23.44	-24.53
CW27 (HNI1)	584321.0	5837804.1	-22.77	-22.96	-22.11	-23.54	-22.11	-23.79
CW28 (HNL2)	587258.4	5835461.1	-23.20	-23.39	-22.85	-23.80	-22.85	-23.83
CW29 (HNG4)	581594.0	5842346.7	-23.99	-24.20	-23.68	-24.51	-23.62	-24.53
CW30 (HNJ1)	585788.7	5838012.8	-21.81	-22.05	-21.45	-22.43	-21.45	-22.62
CW31 (HNG1)	585018.0	5839042.1	-23.19	-23.33	-22.74	-23.78	-22.74	-23.81
CW32 (HNG2)	583938.1	5840359.5	-23.93	-24.04	-23.55	-24.45	-23.53	-24.47
CW33 (HNG3)	583047.3	5841939.4	-23.50	-23.70	-23.17	-24.09	-23.15	-24.09
CW34 (HNG5)	582124.7	5843083.4	-23.59	-23.82	-23.22	-24.22	-23.19	-24.22
CW35 (HNG6)	582655.5	5843820.1	-22.48	-22.62	-22.10	-23.04	-22.09	-23.07
CW36 (HNK1)	587006.8	5838733.6	-24.46	-24.70	-23.99	-25.13	-23.99	-25.30
CW37 (HNF1)	586428.5	5840370.0	-22.51	-22.63	-22.15	-23.07	-22.12	-23.14
CW38 (HNF2)	585391.4	5841773.3	-23.66	-23.73	-23.13	-24.31	-23.09	-24.31
CW39 (HNF3)	584375.8	5843708.6	-24.28	-24.40	-23.88	-24.83	-23.87	-24.83
CW40 (HNF4)	583505.1	5844999.4	-22.55	-22.75	-22.16	-23.13	-22.15	-23.17
CW41 (HNE1)	587675.8	5840894.2	-22.66	-22.74	-22.12	-23.35	-22.11	-23.63
CW42 (HNA1)	589107.4	5839613.1	-23.69	-23.91	-22.93	-24.41	-22.85	-24.90
CW43 (HNF5)	584049.5	5845757.3	-22.88	-23.07	-22.49	-23.41	-22.47	-23.43
CW44 (HNE2)	586669.2	5842650.6	-24.72	-25.02	-24.19	-25.53	-24.15	-25.67
CW45 (HNE3)	586090.2	5843867.6	-24.16	-24.27	-23.32	-24.96	-23.27	-25.18
CW46 (HNA2)	589945.8	5840010.6	-21.25	-21.65	-20.83	-22.24	-20.72	-23.39
CW47 (HNE6)	584593.8	5846515.1	-23.72	-23.83	-23.17	-24.45	-23.15	-24.48
CW48 (HNE4)	585662.8	5845292.0	-24.10	-24.23	-23.52	-24.89	-23.44	-24.89
CW49 (HNB1)	588972.9	5841047.2	-22.91	-23.01	-22.41	-23.59	-22.37	-24.04
CW50 (HNE5)	585138.2	5847273.0	-24.81	-25.00	-24.27	-25.53	-23.54	-25.98
CW51 (HNA3)	590896.0	5840519.7	-20.77	-20.88	-20.39	-21.29	-20.39	-21.40
CW52 (HNC1)	589631.9	5842256.2	-22.75	-22.83	-22.32	-23.32	-21.97	-23.57
CW53 (HND1)	588779.5	5843495.2	-22.96	-23.32	-22.50	-23.95	-21.77	-24.08
CW54 (HND2)	587940.7	5844878.7	-23.84	-23.84	-23.49	-24.21	-23.43	-24.21
CW55 (HNA4)	591715.0	5841170.1	-18.91	-19.08	-18.51	-19.53	-18.45	-19.55
CW56 (HND3)	587558.4	5846131.8	-24.20	-24.22	-23.84	-24.61	-23.77	-24.61
CW57 (HNA5)	591680.7	5842072.4	-19.87	-19.96	-19.60	-20.41	-19.60	-20.47
CW58 (HND4)	587382.1	5847440.0	-25.51	-25.70	-25.11	-26.17	-24.96	-26.24
CW59 (HND6)	586152.3	5848683.4	-25.24	-25.39	-24.74	-25.97	-24.74	-26.49
CW60 (HNB2)	591666.4	5842974.7	-20.19	-20.30	-19.90	-20.94	-19.90	-20.98
CW61 (HNB3)	591683.4	5843881.8	-21.94	-21.36	-21.00	-22.33	-20.76	-22.33
CW62 (HND5)	587287.8	5848975.7	-24.19	-24.19	-23.71	-24.70	-23.52	-24.70
CW63 (HNB4)	591740.3	5844783.3	-20.99	-21.38	-20.59	-21.86	-20.59	-22.23
CW64 (HNB5)	591165.6	5845580.7	-21.68	-22.31	-20.40	-23.81	-20.40	-25.55
CW65 (HNC2)	590669.9	5846380.0	-21.74	-22.59	-21.16	-23.07	-20.75	-23.98
CW66 (HNC3)	590162.8	5847137.8	-21.55	-21.77	-21.23	-22.20	-21.23	-23.65
CW67 (HNC4)	589655.6	5847895.5	-21.67	-21.90	-21.38	-22.12	-21.38	-22.37
CW68 (HNC5)	589148.5	5848653.3	-21.90	-22.06	-21.52	-22.49	-21.52	-23.51
CW69 (HNC6)	588408.4	5849319.7	-22.78	-22.76	-22.28	-23.24	-22.20	-23.24
CW70 (HNA6)	590719.1	5841602.3	-20.50	-20.99	-20.04	-21.58	-20.04	-22.20

NOTES

GEODETIC INFORMATION

Source Spheroid : ETRS 1989
Target Spheroid : ETRS 1989
Projection : Universal Transverse Mercator (UTM) Zone 31 North (Central Meridian 3° East)
Central Meridian (CM): 3° East
Latitude of Origin: 0.0°
False easting: 500,000m
False northing: 0m
Scale Factor on CM: 0.9996

Vertical Datum : LAT

REFERENCES:

Boundaries and Site Coordinates
- HKN_20190815_Project and Site Description_Appendix C - Memo Boundaries & Coordinates-F

Bathymetry
Bathy 2017
- HKN_20180924_Geophysical Survey_Fugro_Combined Certified Result Report - F
BE-2023, HSBL-2023 LSBL-2023, HSBL-2048 and LSBL-2048
- HKN_20190409_Deltares_Morphodynamics and Scour Mitigation-F

Archaeological objects, Magnetic Anomalies:
- HKN_20190815_Project and Site Description_Appendix C - Memo Boundaries & Coordinates-F

Boulders, Background obstructions, SSS targets, cleared UXOs
- RVO HKN (GIS database)

Existing Pipes and Cables
- HKN_20180924_Geophysical Survey_Fugro_Appendices - F
- HKW Export Cable Routing RPLB09_Rev02_KP

As-laid data UK-NL-14
- CWHKN-TRANSMIT-000541

MICROSITING
- HKN-A.01.00_App5_Annex_3_HKN-D.01.04_BoP_Lay-outs_V2

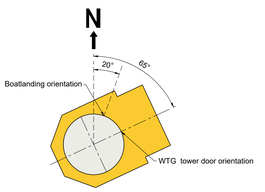
CABLE ROUTING
Route Engineering & Cable length overview
- 144671-VOOW-INF-ENG-TN-3004 IAC Route Engineering

LEGEND

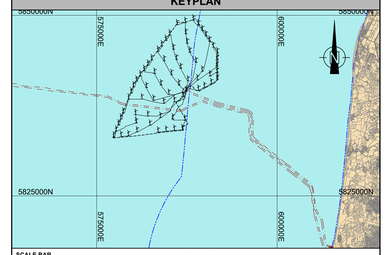
Wind turbine
Offshore substation
Existing platform
Infield cable
Contours bathymetry
Nautical 12 mile border
Proposed wind park border
HKN export cable 1 & 2
HKW export cable 1 & 2
Existing pipes
Existing cables
Existing abandoned cables
UK-Netherlands 14 cable
Maintenance zone I, II and III
Cable entry zone
Downtime measure zone
Envisaged future floating solar
(Wrecks with) possible archaeological objects including 100m buffer zone.
Magnetic anomalies including 100m buffer zone.
RVO HKN boulders
RVO HKN background obstructions
RVO HKN SSS target list
RVO HKN background cleared UXO

PRE-SURVEY COLORBAR
-15.0
-17.5
-20.0
-22.5
-25.0
-27.5
-30.0

WTG ORIENTATION



KEYPLAN



SCALE BAR
SCALE 1:25000
0.0 1250.0 2500.0

CLIENT
CROSSWIND

CONTRACTOR
Van Oord
Marine ingenuity

PROJECT NAME
HOLLANDSE KUST NOORD WIND FARM ZONE

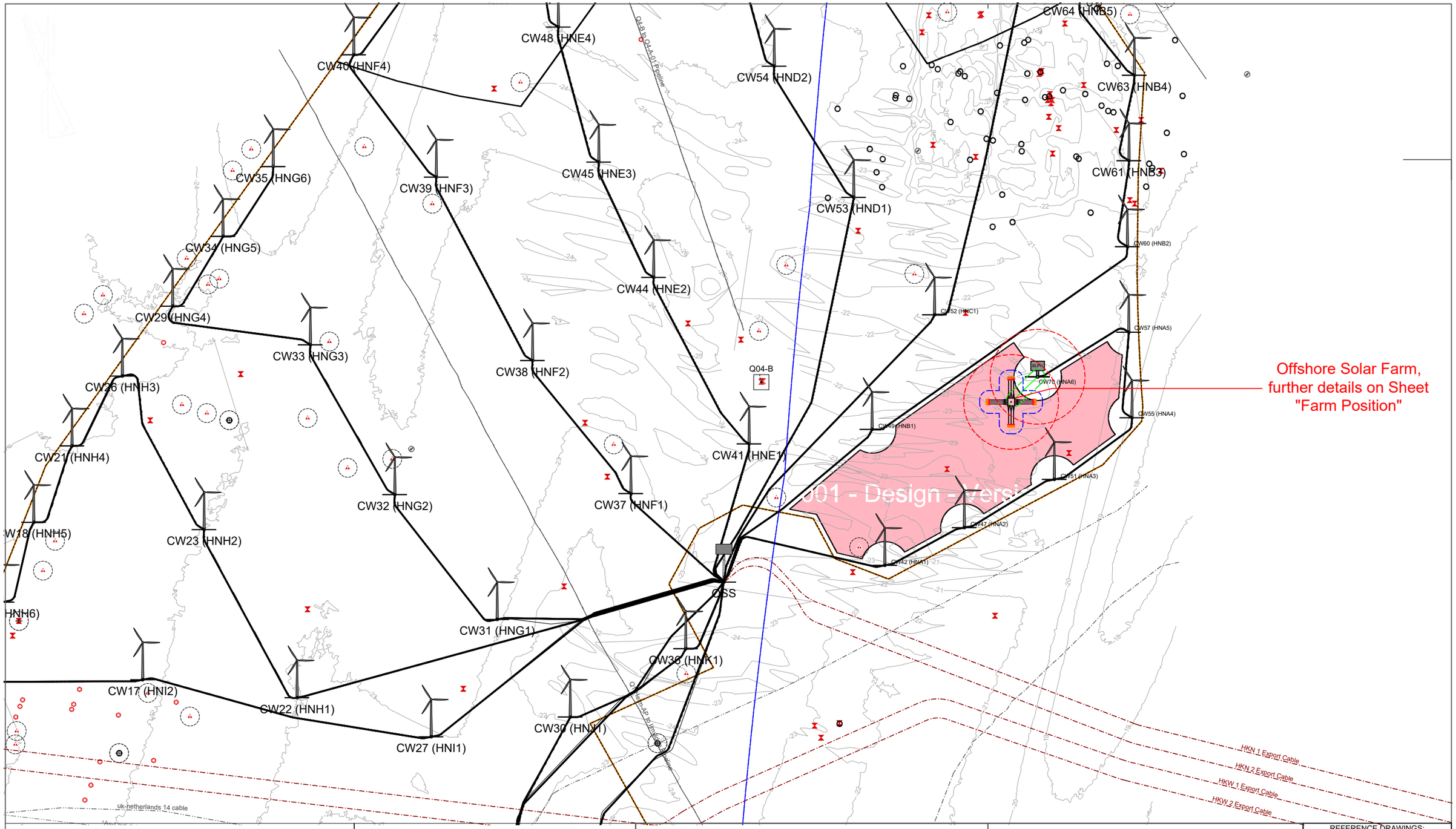
Rev	Date	Description	Prepared	Checked	Approved	Client
2	17 Sept 2021	FINAL	YLP	SOB	FPN	
1	27 Aug 2021	FINAL	YLP	SOB	FPN	
0	1 Apr 2021	FINAL	GSC	SOB	VJT	

DRAWING TITLE
HKN WFZ
WTG Coordinates & Cable Routing

Van Oord Project/Dwg. No.	144671-VOOW-TF-ENG-DWG-0001	1:25000 Scale	A0 Size
Client Dwg. No.		1 of 1 Sheet	2 Cur. Rev.

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Attachment 4 – Field information Ocean of Energies



001 - Design - Versi

General Notes:

- Field layout with respect to wind farm and BLPH location
- For safety zones refer to Sheet 2
- For offshore floating solar farm position with respect to BLPH refer to Sheet 3
- For the anchor coordinates during installation refer to Sheet 4
- For the specific offshore solar farm layout refer to HKN1-01-DWG-310 Farm General Arrangement
- For the specific mooring layour refer to HKN1-03-DWG-311 Mooring Layout Drawing

Geodetic information:

Spheroid:	ETRS 1989
Projection:	Universal Transverse Mercator (UTM)
Zone:	31 North
Central Meridian (CM):	3° East
Latitude of origin:	0.0°
False Easting:	500000m
False Northing:	0m
Scale factor:	0.9996cm
Vertical datum :	Lowest Astronomical Tide (LAT)

Oceans of Energy

	DATE	NAME
DRAWN	25-03-2024	ADG
CHK'D	02-04-2024	MAA
APPV'D	02-04-2024	QVC

SCALE BAR: 0.0 — 500m — 2000m

DRAWING NUMBER: HKN1-01-DWG-311

TITLE: Overview Location HKN1

SHEET: 1

REV.: D

SIZE: A3

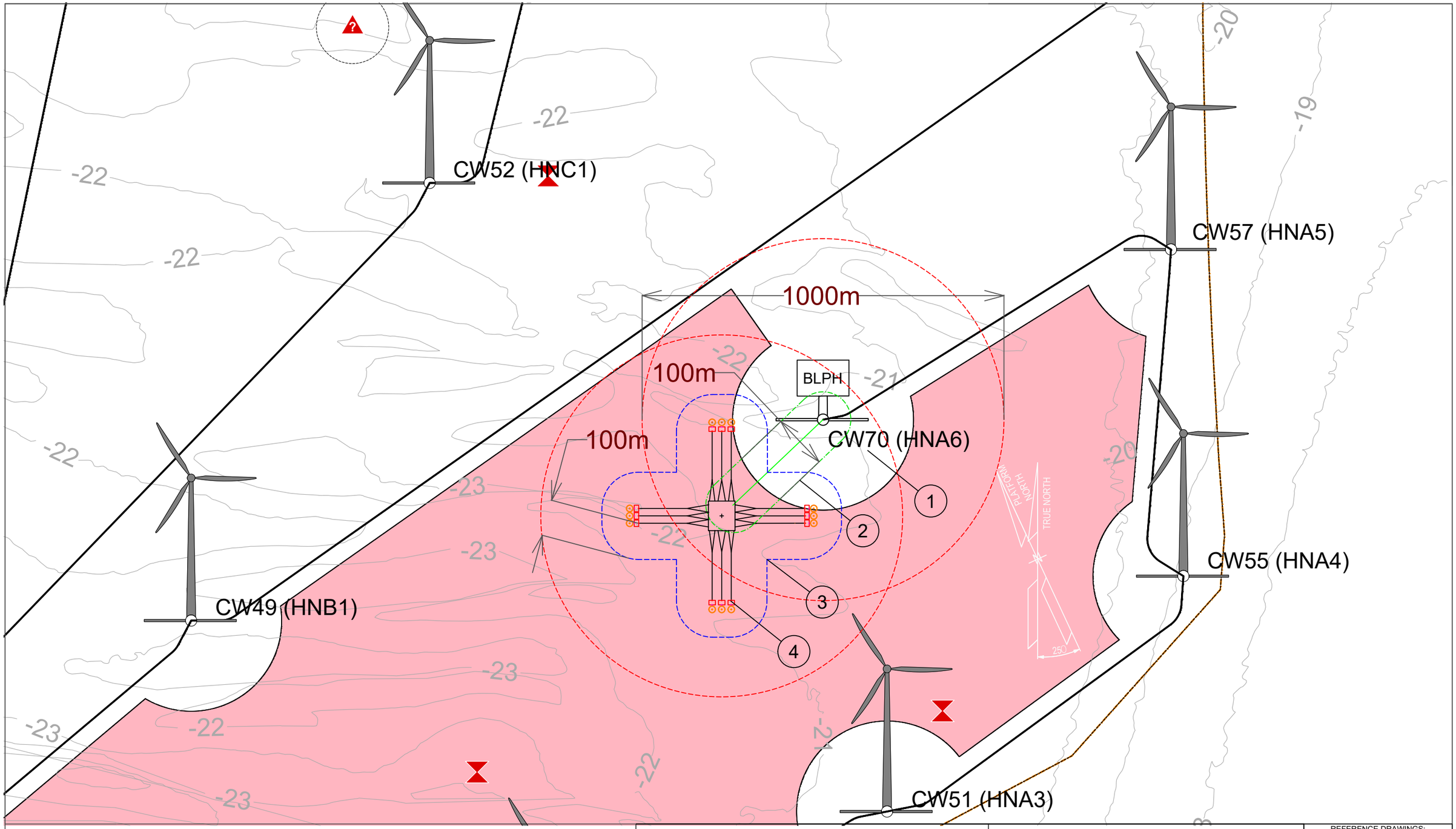
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REFERENCE DRAWINGS:

DOCUMENT NUMBER	DOCUMENT DESCRIPTION
HKN1-03-DWG-311	MOORING LAYOUT DRAWING
HKN1-01-DWG-310	FARM GENERAL ARRANGEMENT
CWHKN-INN-BPH-DWG-00022	BLPH SAFETY ZONES INC. INSTALLATION AND SOLAR FARM

REVISION:

REV.	DATE	DESCRIPTION	DRW'D	CHK'D	APPR'D
K					
J					
I					
H					
G					
F					
E					
D		Anchor points included with drop down positions for installation as of HKN1-03-DWG-311 Mooring Layout Drawing	ADG		
C	5/12/2023	CRS feedback, safety zones and cable routing updated	ADG	QVC	JBR
B	7/7/2023	Safety zones included	ASC	HLU / FJK	MVI
A	4/7/2023	Initial document	ASC	HLU / FJK	MVI



General Notes:

- WTG safety zone including inputs from CWHKN-INN-BPH-DWG-00022 (pink)
- BLPH & Offshore Solar Farm Safety zones of 500m in radius for AIS Systems included (dashed red)
- Exclusion zone for offshore solar farm including mooring with 100m offset from mooring lines positions (dashed blue)
- Site navigational marking not shown in this drawing, to be established based on Company and permit requirements
- Contractor to have access to all safety zones at all time, during offshore solar farm operational period

(1) Wind turbine safety zone (as provided by HKN wind farm)

(2) Power export cable safety zone (50m per side)

(3) Offshore solar farm safety zone (100m from anchors)

(4) Offshore solar farm anchors locations

Oceans of Energy

	DATE	NAME
DRAWN	25-03-2024	ADG
CHK'D	02-04-2024	MAA
APPV'D	02-04-2024	QVC

SCALE BAR: 0.0 100m 400m

DRAWING NUMBER: HKN1-01-DWG-311

TITLE: Safety Zones

SHEET: 2

REV.: D

SIZE: A3

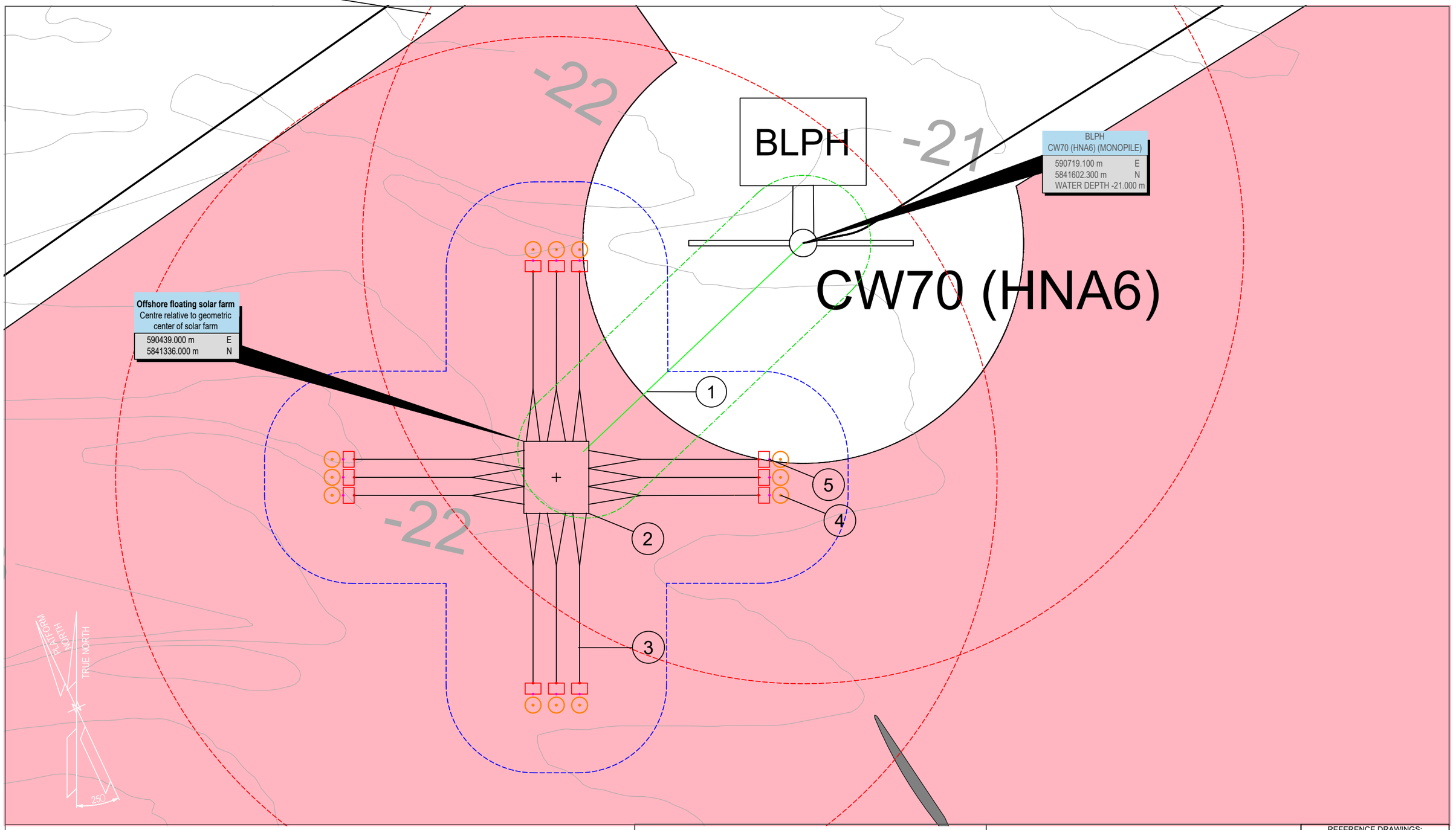
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REFERENCE DRAWINGS:

DOCUMENT NUMBER	DOCUMENT DESCRIPTION
HKN1-03-DWG-311	MOORING LAYOUT DRAWING
HKN1-01-DWG-310	FARM GENERAL ARRANGEMENT
CWHKN-INN-BPH-DWG-00022	BLPH SAFETY ZONES INC. INSTALLATION AND SOLAR FARM

REVISION:

REV.	DATE	DESCRIPTION	DRW'D	CHK'D	APPR'D
K					
J					
I					
H					
G					
F					
E					
D		Anchor points included with drop down positions for installation as of HKN1-03-DWG-311 Mooring Layout Drawing	ADG		
C	5/12/2023	CRS feedback, safety zones and cable routing updated	ADG	QVC	JBR
B	7/7/2023	Safety zones included	ASC	HLU / FJK	MVI
A	4/7/2023	Initial document	ASC	HLU / FJK	MVI



General Notes:

- Relative distance to BLPH: 385m
- Dashed lines refering to safety zones of solar farm (including mooring), power export cable and BLPH
- Anchor locations included in red including anchor tolerance

(1) Power export cable routing layout. For specifics on cable layout, bouyancy elements and touch down zones to refer to HKN1-04-DWG-354

(2) Farm layout as per HKN1-01-DWG-311 Farm General Arangement

(3) Mooring layout as per HKN1-03-DWG-311 Mooring Layout Drawing

(4) Anchor locations nominal drop-down position during installation

(5) Drag distance (minimum to maximum)

Oceans of Energy

	DATE	NAME
DRAWN	25-03-2024	ADG
CHK'D	02-04-2024	MAA
APPV'D	02-04-2024	QVC

SCALE BAR: 0.0 50m 200m

DRAWING NUMBER: HKN1-01-DWG-311

TITLE: Farm Position

SHEET: 3

REV. D

SIZE: A3

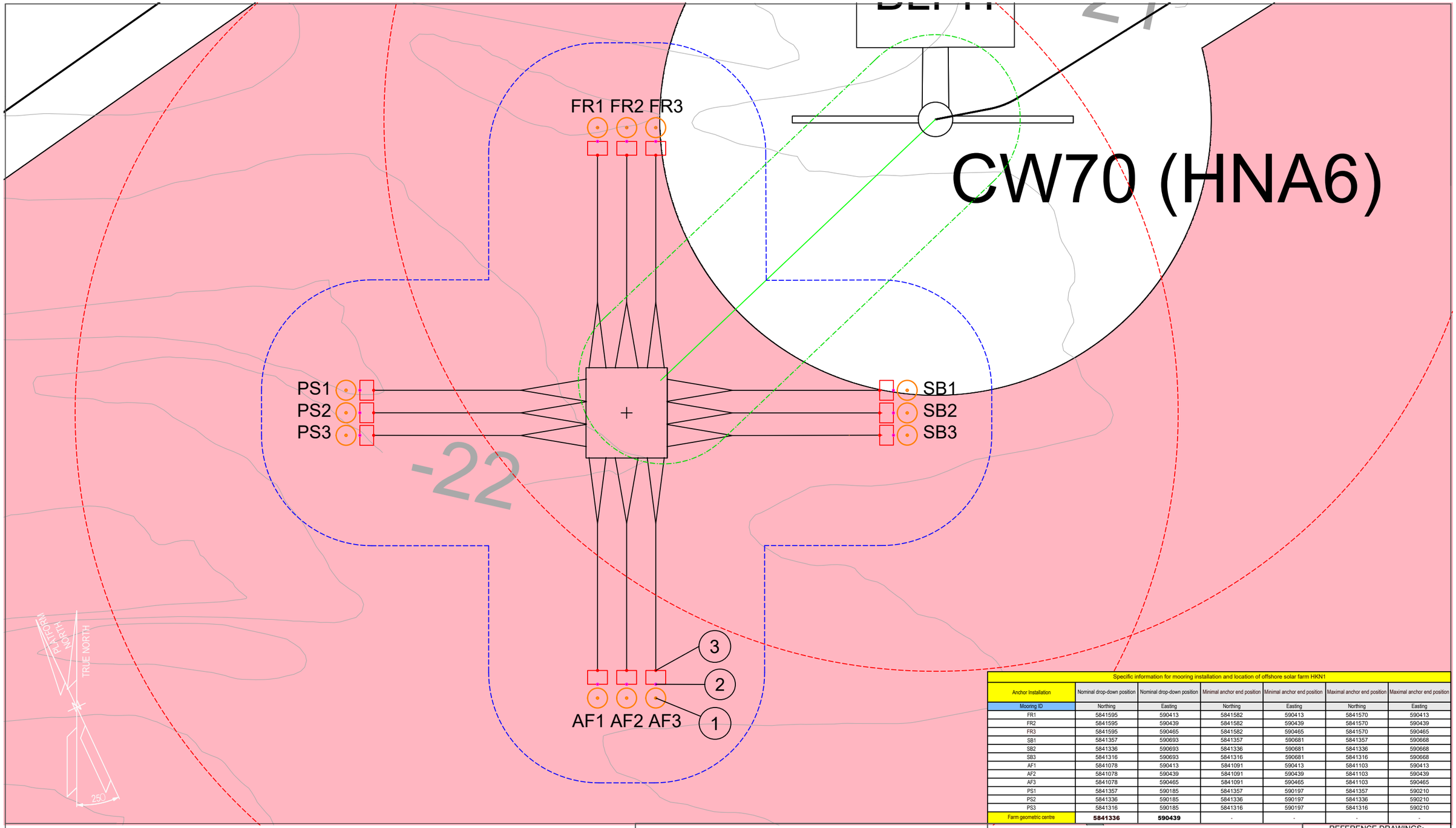
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REFERENCE DRAWINGS:

DOCUMENT NUMBER	DOCUMENT DESCRIPTION
HKN1-03-DWG-311	MOORING LAYOUT DRAWING
HKN1-01-DWG-310	FARM GENERAL ARRANGEMENT
CWHKN-INN-BPH-DWG-00022	BLPH SAFETY ZONES INC. INSTALLATION AND SOLAR FARM

REVISION:

REV.	DATE	DESCRIPTION	DRWD	CHK'D	APPR'D
K					
J					
I					
H					
G					
F					
E					
D		Anchor points included with drop down positions for installation as of HKN1-03-DWG-311 Mooring Layout Drawing	ADG		
C	5/12/2023	CRS feedback, safety zones and cable routing updated	ADG	QVC	JBR
B	7/7/2023	Safety zones included	ASC	HILU / FJK	MVI
A	4/7/2023	Initial document	ASC	HILU / FJK	MVI



Specific information for mooring installation and location of offshore solar farm HKN1

Anchor Installation	Nominal drop-down position	Nominal drop-down position	Minimal anchor end position	Minimal anchor end position	Maximal anchor end position	Maximal anchor end position
Mooring ID	Northing	Easting	Northing	Easting	Northing	Easting
FR1	5841595	590413	5841582	590413	5841570	590413
FR2	5841595	590439	5841582	590439	5841570	590439
FR3	5841595	590465	5841582	590465	5841570	590465
SB1	5841357	590693	5841357	590681	5841357	590668
SB2	5841336	590693	5841336	590681	5841336	590668
SB3	5841316	590693	5841316	590681	5841316	590668
AF1	5841078	590413	5841091	590413	5841103	590413
AF2	5841078	590439	5841091	590439	5841103	590439
AF3	5841078	590465	5841091	590465	5841103	590465
PS1	5841357	590185	5841357	590197	5841357	590210
PS2	5841336	590185	5841336	590197	5841336	590210
PS3	5841316	590185	5841316	590197	5841316	590210
Farm geometric centre	**5841336**	**590439**	-	-	-	-

General Notes:

- Anchor positions, naming and coordinates included with reference to their nominal drop-down position during installation, maximal anchor end position and minimal anchor end position (coordinates rounded to the meter)
- For information on mooring system refer to HKN1-03-DWG-311 Mooring Layout Drawing

(1) Anchor nominal drop-down position

(2) Minimal anchor end position

(3) Maximal anchor end position

Oceans of Energy

SCALE BAR: 0.0 — 100m — 300m

	DATE	NAME
DRAWN	25-03-2024	ADG
CHK'D	02-04-2024	MAA
APPV'D	02-04-2024	QVC

DRAWING NUMBER: HKN1-01-DWG-311

TITLE: Anchor positions

SHEET: 4 REV. D

SIZE: A3

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REFERENCE DRAWINGS:

DOCUMENT NUMBER	DOCUMENT DESCRIPTION
HKN1-03-DWG-311	MOORING LAYOUT DRAWING
HKN1-01-DWG-310	FARM GENERAL ARRANGEMENT
CWHKN-INN-BPH-DWG-00022	BLPH SAFETY ZONES INC. INSTALLATION AND SOLAR FARM

REVISION:

REV.	DATE	DESCRIPTION	DRW'D	CHK'D	APPR'D
K					
J					
I					
H					
G					
F					
E					
D		Anchor points included with drop down positions for installation and HKN1-03-DWG-311 Mooring Layout Drawing	ADG		
C	5/12/2023	CRS feedback, safety zones and cable routing updated	ADG	QVC	JBR
B	7/7/2023	Safety zones included	ASC	HLU / FJK	MVI
A	4/7/2023	Initial document	ASC	HLU / FJK	MVI