Base Load Power Hub (BLPH)

TRANSPORT MANUAL

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1 INTRODUCTION

1.1 PROJECT OVERVIEW

Crosswind, a Shell and Eneco joint venture, was awarded the tender to develop the offshore Hollandse Kust Noord (HKN) wind farm, located 18.5km off the coast of Netherlands near the town of Egmond aan Zee. The consortium plans to have HKN operational in 2023 with an installed capacity of 759MW generating at least 3.3TWh per year. This is sufficient renewable power to supply more than 1 million Dutch households with green electricity.

Offshore wind farms produce intermittent electricity and balancing these dips and peaks and integrating this electricity into the national energy system requires new technologies. For this reason, the offshore wind farm will include several new technologies that could be implemented at full-scale in the future. The new technologies being explored include a floating solar park, a short-duration battery storage as well as long-term storage via green hydrogen produced by water electrolysis and subsequently consumed in a fuel cell. The combination of these individual measures, herein referred to as the Base Load Power Hub (BLPH) will ensure a continuous power supply regardless of the wind situation.

1.1.1 Project Location

The Hollandse Kust Noord (HKN) wind farm is located 18.5km off the coast of the Netherlands near the town of Egmond aan Zee.

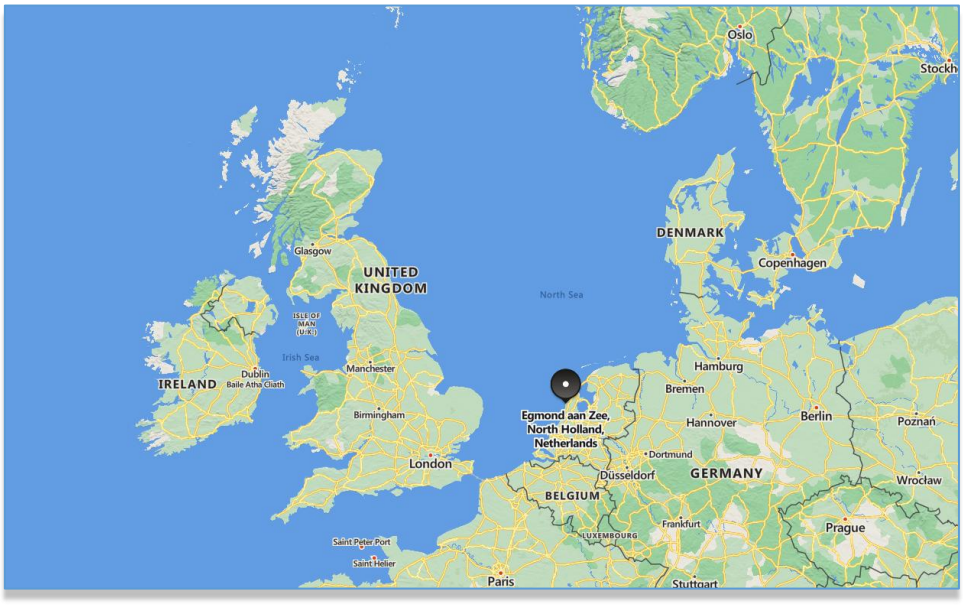


Figure 1 - HOLLANDSE KUST NOORD WIND PARK Location Map

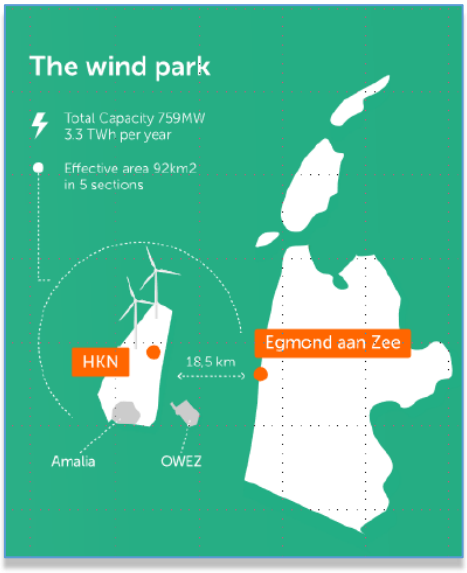


Figure 2 - Wind Park Details

The wind farm will consist of No. 69 x 11.5MW wind turbine generators each to be installed on a dedicated monopile structure. A 70th monopile located on coordinates E 590719.1, N 5841602.3 is reserved for installing the platform accommodating the BLPH. The monopile structure was designed and installed by Van Oord Offshore Wind (VooW) and therefore not part of the BLPH scope.

1.1.2 Project Concept

All components included in the BLPH will be integrated onshore on a topsides and installed in an offshore location within the boundaries of the HKN wind farm. At its simplest, the BLPH will store energy during periods of high electricity generation from renewable sources (a wind turbine generator and the floating solar PV farm) and release it during periods of low generation. In practice. It is expected that the energy stored will supplement generation from renewable sources to ensure that at least 1.0MW of power is exported to the electrical grid regardless of wind/solar availability.

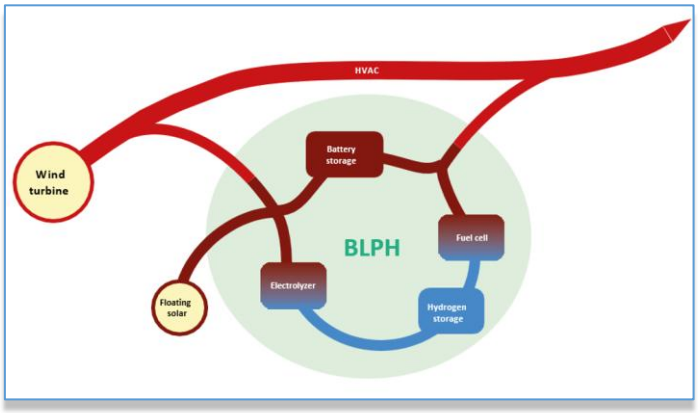


Figure 3 – BLPH Concept

Electricity in the BLPH will be stored in the form of electrons in a battery energy storage system (BESS) as well as converted into green hydrogen via water electrolysis. When the power output from the connecting wind turbine drops to below 1 MWe, the BLPH will return its stored energy to supplement the remaining power output. This will be by discharging the BESS, while stored hydrogen will be converted back into electricity using a fuel cell to extend the discharge duration.

The purpose of the BLPH s to function as a testbed for the integration of energy storage technologies with renewable generation. It is expected that equipment installed on the BLPH will operate as Normally Unmanned Installation for at least two (2) years with no or minimal maintenance and it will have its own independent control room with the ability to communicate with Crosswind's control room.

2 DOCUMENT SCOPE

This report presents the information, certificates, and instruction necessary to perform the transportation from Ravenna (Italy) to Eemshaven port (The Netherland) of the BLPH topside, transition piece and caissons.

- Start of Towing = Ravenna (IT)
- End of Towing = Eemshaven (NL)
- Tow window = June 2025
- Time of Tow = about 27 days (+3 days contingency)
- Tow type = Restricted Tow

The selected transportation barge is VERVECE cargo barge, owned by OCEAN, towed by AHT-Fort tug. Details of marine spread is presented in Section 6. The following figure and Table present the arrangement on barge deck and transported items weights. The assumed barge draft is set equal to 2.50m.

cargo ID	cargo description	W (ton)	(CoG coordinates from: bow / CL / deck)		
			x (m)	y (m)	z (m) excluded barge height (6.10m)
BLPH	BLPH topside	1802	31.16	-1.24	9.67
TP	Transition Piece	290	65.41	-2.42	5.70
BLPH-GS	Topside grillage and SF	75	30.86	-1.14	1.25
TP-GS	TP grillage and SF	45	65.20	-2.92	1.30
CF	Caisson Frame	26	69.38	11.22	1.45
CF-GS	Caisson Frame grillage and SF	0.5	67.44	11.22	1.00
		2238.5 t			

Table 1 – Transported loads

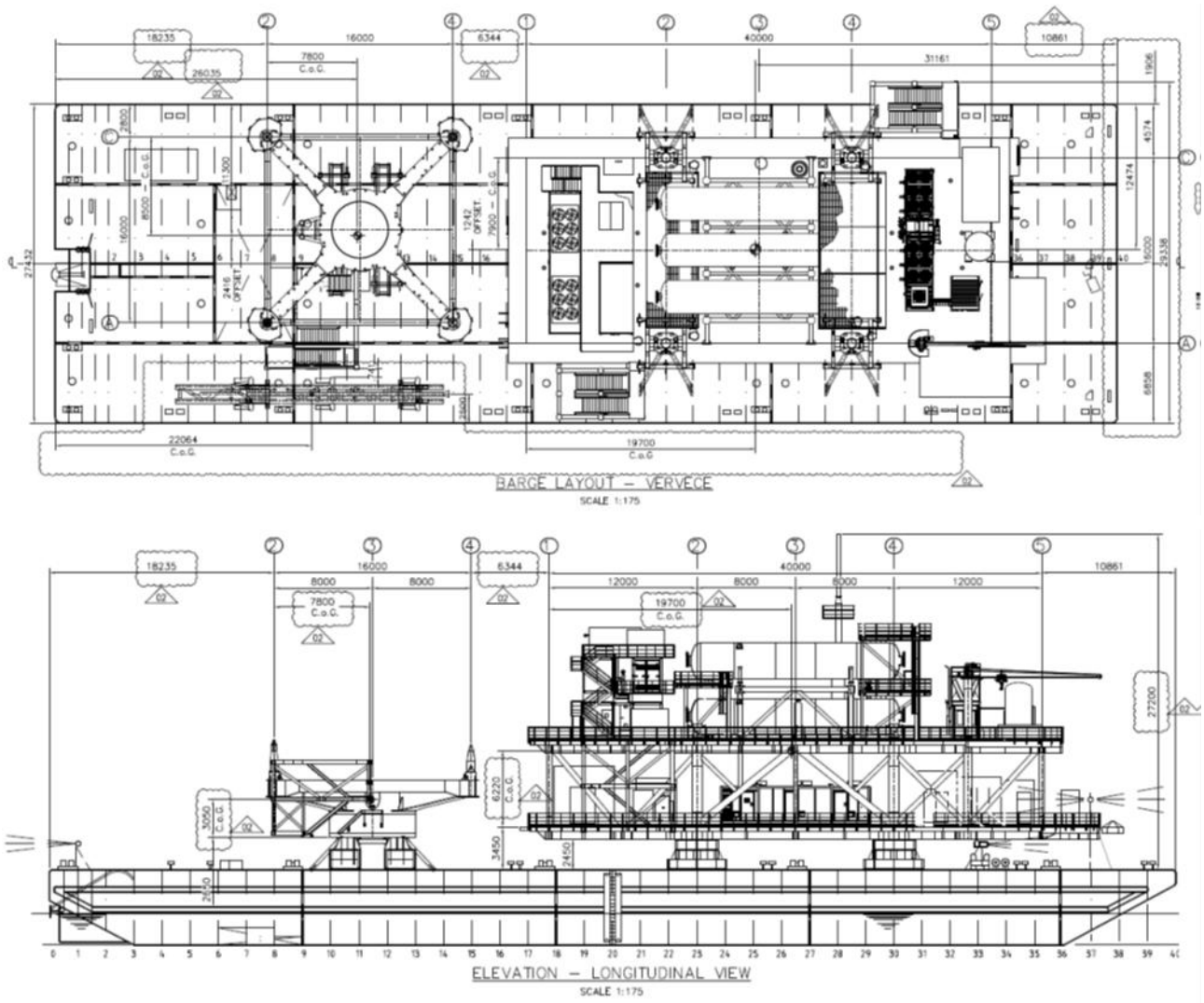


Figure 4 – Barge Layout and view

3 REFERENCES

3.1 CODES AND STANDARDS

Doc. No.	Description
/1/ BS EN ISO 19901-6	Specific requirements for offshore structures – Part 6: Marine Operations – 2009
/2/ DNV-ST-N001	DNV - Marine operation and marine warranty - 2021
/3/ DNV-ST-0145	DNV, Offshore substations
/4/ DNV-RP-C203	DNV, Fatigue design of offshore steel structures, September 2019 and Amendment January 2020
/5/ DNV-RP-C205	DNV - Environmental conditions and environmental loads - September 2019, amended September 2021.
/6/ DNV-ST-0126	Support structures for wind turbine, 2018

3.2 COMPANY SPECIFICATIONS

Doc. No.	Description
/7/ DEP 37.19.00.12	Gen - Offshore Topsides Structures
/8/ DEP 37.19.00.30	Gen - Fixed Steel Offshore Structures (Adoption of IOGP S-631-11, Amendments / Supplements to ISO 19902:2020).
/9/ DEP 37.81.10.19	Gen - Marine Operations Requirements – Loadout, Transportation and Installation of Offshore Structures (Amendments / Supplements to ISO 19901-6)

3.3 PROJECT DOCUMENTS

Doc. No.	Description
/10/ 123A90-DDL-ST-SP-90017	Structural Design Basis
/11/ 123A90-DDL-MD-RE-01006	Monthly Weight Report – rev. July 24
/12/ 123A90-DDL-PP-DS-70070	BLPH Platform - Plot Plan Lower & Upper Deck
/13/ 123A90-DDL-ST-SP-90018	Structural Material Specification for Topside and TP
/14/ 123A90-DDL-ST-SP-90118	Structural Material Specification for Flange and Bolts
/15/ 123A90-DDL-TI-SP-99014	Specification for TP, Topside and Caissons Transportation and Installation
/16/ 123A90-DDL-TI-DD-99015	BLPH Platform – Barge Layout

/17/ 123A90-DDL-ST-TN-90119	Evaluating ISO and DNV Approaches
/18/ 123A90-DDL-TI-DD-99021	BLPH – Topside – Grillage Assembly
/19/ 123A90-DDL-TI-DD-99023	BLPH – Topside – Grillage – Plan and Section
/20/ 123A90-DDL-TI-DD-99024	BLPH – Sea Fastening - Assembly
/21/ 123A90-DDL-TI-DD-99025	BLPH – Sea Fastening - Details
/22/ 123A90-DDL-ST-RE-90002	BLPH – Topside Transportation Analysis
/23/ 123A90-DDL-ST-RE-90003	BLPH – Topside Fatigue Transportation Analysis
/24/ 123A90-DDL-TI-RE-99001	BLPH – Topside Grillage and Sea Fastening Design Report
/25/ 123A90-DDL-TI-RE-99003	Validation of TP Grillage and SF on barge Vervece
/26/ 123A90-DDL-TI-RE-99004	TP – Grillage and Sea Fastening Design Report
/27/ 123A90-DDL-TI-DD-99036	BLPH - TP - Upper Grillage - Plan View
/28/ 123A90-DDL-TI-DD-99037	BLPH - TP - Upper Grillage - Sections
/29/ 123A90-DDL-TI-DD-99038	BLPH - TP - Upper Grillage - Sections and Details
/30/ 123A90-DDL-TI-DD-99039	TP - Sea Fastening Drawing – Assembly
/31/ 123A90-DDL-TI-DD-99040	TP - Sea Fastening Drawing - Details
/32/ 123A90-DDL-ST-RE-90010	TP – Transportation Fatigue Analysis
/33/ 123A90-DDL-ST-RE-90015	Caisson Frame – In service, Lifting and transportation design report
/34/ 123A90-DDL-ST-DD-90094	Caisson frame – Elevations
/35/ 123A90-DDL-ST-DD-90095	Caisson frame - Details
/36/ 123A90-DDL-ST-DD-90096	Caisson frame - Details
/37/ 123A90-DDL-TI-DD-99007	Caisson – Grillage and Sea fastening Design report
/38/ 123A90-DDL-TI-DD-99047	CF – Grillage drawing
/39/ 123A90-DDL-TI-DD-99048	CF – Sea fastening drawing
/40/	Vervece Stability booklet
/41/ 123A90-DDL-TI-DD-99009	Transport Barge Stability and BP calculation

4 DEFINITIONS AND ABBREVIATIONS

COMPANY or Client (CPY)	Crosswind
CONTRACTOR (CTR)	ROSETTI MARINO S.p.A.
PROJECT	HOLLANDSE KUST NOORD WIND PARK Project
TRANSPORT CONTRACTOR	OCEAN
BLPH	Base Load Power Hub
BESS	BATTERY ENERGY STORAGE SYSTEM
BLPH	Base Load Power Hub
BP	Bollard Pull
CF	Caisson Frame
CL	Concentrated Load
CoG	Centre of Gravity
CTV	Crew Transfer Vessel
CW	CrossWind
DAF	Dynamic Amplification Factor
DFF	Damage Fatigue Factors
DNV	Det Norske Veritas
El.	Elevation
EPCI	Engineering Procurement Construction and Installation
FEED	Front End Engineering Design
HAT	Highest Astronomical Tide
HKN	Hollandse Kust Noord
LAT	Lowest Astronomical Tide
LRFD	Load and Resistance Factor Design
MSL	Mean Sea Level
NTE	Not-to-Exceed
OD	Outside Diameter
PAU	Pre-Assembled Unit (H2 Vessels)
PG	Plate Girder

T&I	Transport & Installation
ToS	Top of Steel
TP	Transition Piece
TPR	Towline pull required
UC	Unity Check
UDL	Uniformly Distributed Load
VIV	Vortex Induced Vibration
VOOW	Van Oord Offshore Wind
WTG	Wind Turbine Generator
W2W	Walk to Work

Table 2 - Definitions and Abbreviations

5 ROLES AND RESPONIBILITIES

The general roles and responsibilities for this document are defined as follows:

5.1 MARINE WARRANTY SURVEYOR

The Marine Warranty Surveyor is responsible of the inspection of the transport spread and of the operation. The correct release of the Certificates of Approval relevant to the above inspections is MWS responsibility.

5.2 TUG MASTER

The tug Master remains solely responsible for the tug, for the towing arrangements and for the towing during the voyage.

If any special situations arise during the towage and the Master is unable to comply with any specific recommendations, agreed procedures or International Regulations, then he shall take such measures he deems appropriate for the safety of life and property. MWS, Company and Contractor shall be informed as soon as practical of any such circumstances.

5.3 COMPANY

Company shall approve this document as part of the any towing certificate.

6 MARINE SPREAD

This section presents the selected TUG and cargo barge.

6.1 TRANSPORTATION BARGE DETAILS

The VERVECE barge is used in transporting the Topside, Transition piece and Caisson frame. Details of this barge are as below.

- Barge Name: VERVECE
- LOA: 91.50 m
- Breadth: 27.40 m
- Depth: 6.10 m
- Frame Spacing: 2.286 m
- Light ship: 1833 t
- Towing gear arrangement: see Attachment 1.

6.2 SELECTED TUG

The AHT-Fort tug is used to tow the cargo barge. Details of this Tug are as below.

- Tug Name: Fort
- IMO No. 9388467
- Flag/Port of registry: Madeira/Portugal
- LOA: 45.64 m
- Breadth: 13.20 m
- Depth: 5.30 m
- Bollard pull: 75 t
- Tow wire: MT x dia. mm. See Attachment 2

7 TRANSPORTATION

7.1 NAVAL ANALYSIS

For naval transportation analysis refer to reports Ref./22//23//24/ (topside), /25//26//32/(TP), /33//37/ (CF). The report covers the intact and damaged stability check and the hull longitudinal strength check. All stability and strength requirement are satisfied, Ref. /41/.

7.1.1 Towline Pull Required

The min. bollard pull calculation has been performed considering the towing route, described in section 8.6, for a whole length of about 3200 NM, and the meteorological criteria as per Table 11-17 of Ref./2/.

BP calculation is presented in Ref. /41/.

Table 11-17 Meteorological criteria for calculating TPR (towline pull required)

Section	*Condition*	*H_s(m)*	*Wind (m/sec)*	*Current (m/sec)*
[11.12.2.3]	Standard	5	20	0.5
[11.12.2.3]	Benign weather areas	As agreed with the MWS company but not less than:		
		2	15	0.5
[11.12.2.4]	Limited sea room	Design	Design (1 hour mean)	0.5 or predicted current if greater
[11.12.2.5]	Weather restricted towage	To document that the tow will maintain forward speed under all possible weather conditions and to render probable that the tow can be carried out within T_{POP}		
[11.12.2.6]	<24 hour staged tow or <24 hour jack-up move	3	15	0.5 or predicted current if greater
[11.12.2.7]	Sheltered from waves	As agreed with the MWS company.		

Table 3 – Criteria for TPR

- Significant wave height: Hs = 4 m
- Current speed: 0.5 m/s standard
- Wind speed: 20 m/s standard

The full cargo surfaces have been considered in calculation, hence 30x20m of cargo windage area has been introduced in calculation with shape coefficient 1.30 to consider the exposed plate girders and beams.

7.2 TOWING ARRANGEMENTS

The towing arrangement is shown in the Attachment 1.

Certificates of the towing gears are available on board for MWS inspection and reported in Attachment 1 and 2.

7.3 PREPARATION FOR TOWING

Prior starting the tow the following checks shall be performed as a minimum:

- Check that all cargo items are placed in the correct position, as per structural drawings approved by Client
- Check that all seafastening is installed, welded and NDT inspected as required
- Check that the barge ballast is in accordance with the ballast plan for towing
- Check that the towing line is properly connected

Perform any other checks requested by MWS to obtain the approval for towing.

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8 TOW TO SITE

8.1 NOTIFICATION

Contractor will be responsible for notifying the Harbour Authorities that the tow will commence.

8.2 TUG MOBILIZATION

The Pilot, the towing and port handling tugs will be mobilized in due time to meet the sail away date.

8.3 READINESS REVIEWS

Sail-away barge and tug inspections will be carried out by Warranty Surveyor, Company, Contractor and Tug Master before the decision to commence the tow is made.

8.4 DECISION TO TOW

Based on at least 48 hours good weather forecast information, the decision to commence the tow will be made by common agreement between the Contractor, the Tow Master and the Company, subject to the MWS approval, who will issue the formal sail away authorization.

The tug Master, in consultation with Contractor, Company and MWS will make the final decision to delay the commencement of tow if the weather forecast is not considered safe for the tow.

8.5 MANOEUVRING PLAN

The harbour Pilot and the tug Master shall be in charge of coordinating the manoeuvring of cargo barge from mooring quay to harbour entrance as necessary. If requested by the tug Master additional assistance tugs shall be provided by the towing Subcontractor.

8.6 TOWING ROUTE

The distance between Port of Departure and destination is approximately 3200 nautical miles. The expected tow speed is of approximately five (5) knots which end up with an approximate duration of the tow of about 27 days.

The tug Master is the sole responsible of the selection of the appropriate route in accordance with the local situation and safety of the tow.

The picture here below presents the navigation route.

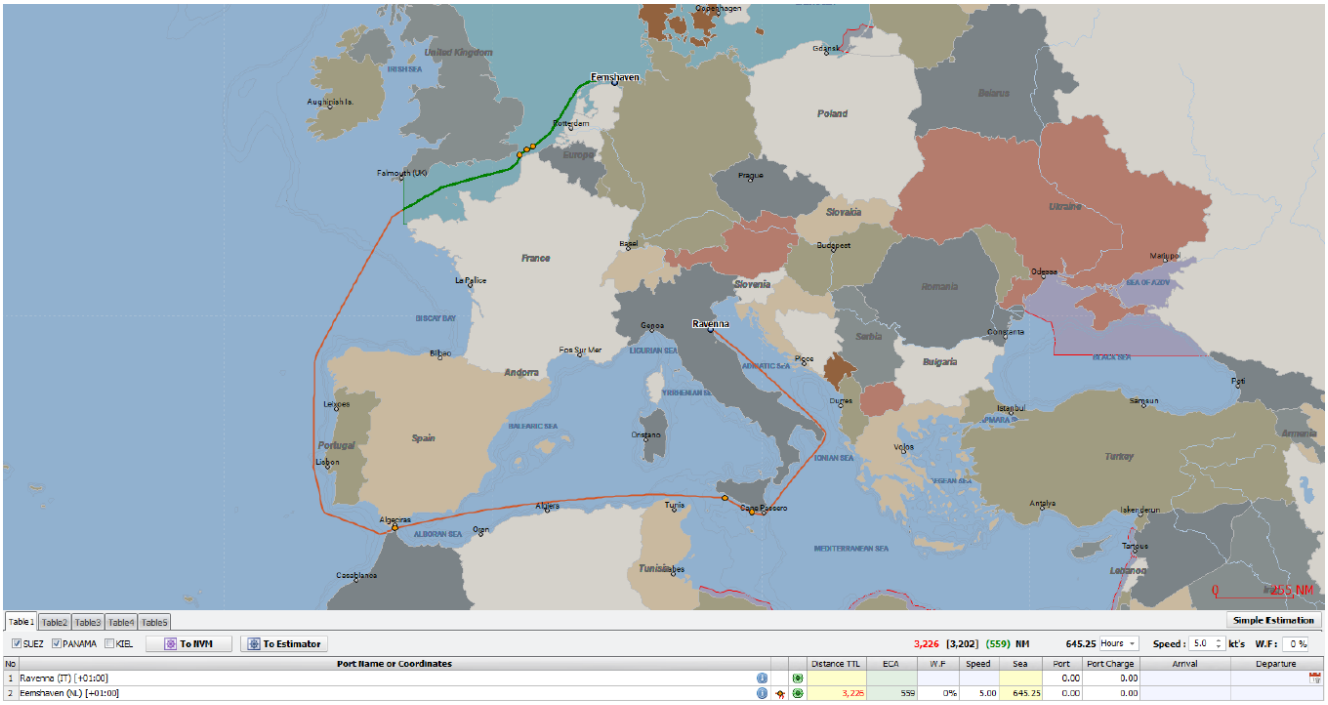


Figure 5 – Towing route from Ravenna

Passage plan prepared by Tug master is attached in Attachment 3.

The following port of refuge/shelter area have been identified over the route, ref. Attachment 4.

8.6.1 Towage to Site

The Tug Master shall endeavour to perform the tow by the shortest and safest route in accordance with the time schedule.

Tug Master during the tow shall always keep radio contact with Company using the means indicated in 7.8.

The liaison between the Contractor and the tug Master will be ensured by the Project Manager or his appointed representatives.

The liaison between Company and the tug Master will be ensured by the Company Representative or his appointed representatives.

8.6.2 Communication Systems and Plan

From departure to arrival, the Tug Master shall keep constant contacts with the Contractor.

The communication system references are reported in the following table:

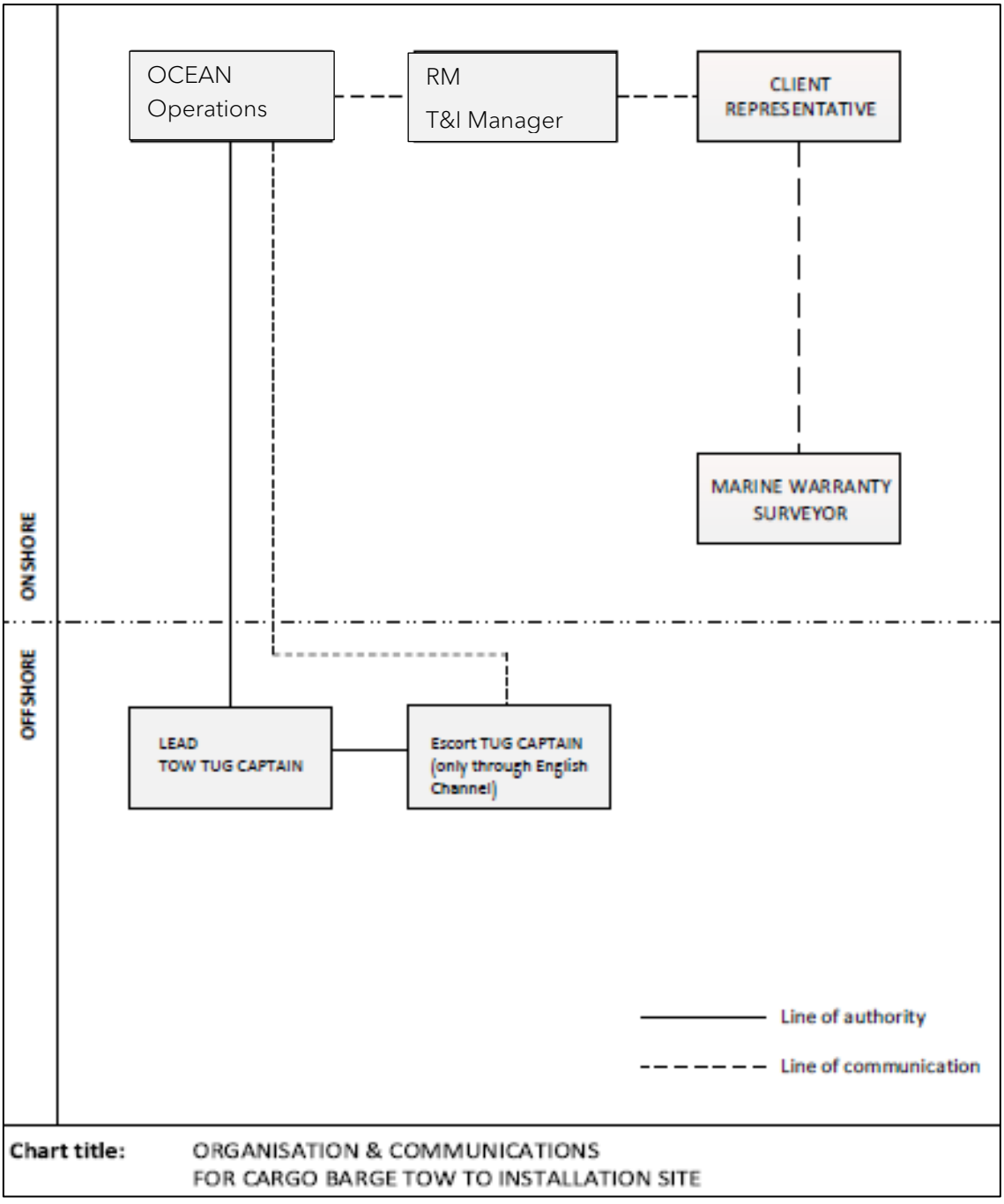


Table 4 – Organization and Communication Chart

8.7 WEATHER FORECAST

Before departure and during the tow the tug Master shall obtain 24 hours weather forecasts two times daily from a minimum 2 independent provider reliable and approved by Contractor.

As minimum the contents of weather reports shall be:

- Sea state.
- Wave height and direction.
- Swell height and direction.
- Wind speed and direction.
- Barometric pressure.
- Predictions and visibility.

Above weather forecasts may be used by the Master to change the route in order to avoid storms.

Contractor and Company shall be notified of any tow route change and any resulting delay.

8.7.1 Operational limits

The transport has been classified as restricted tow, with design seastate criteria of **Hs = 4m**.

Decision during the tow shall be made based on the weather forecast along the course of tow considering the operational limit presented in the next Table.

See below table with alpha factors and operational limits based on DNV-ST-N001, ref./2/, table 2-12 considering Weather forecast level **B.**

Planned Operation Period [Tpop] hours	Alpha factor (α) OPLim **Hs=4m**	Operational limit (Hs) m
<= 4	0.89	**3.56**
<= 12	0.77	**3.08**
<= 24	0.71	**2.84**
<= 36	0.69	**2.76**
<= 48	0.67	**2.68**
<= 72	0.63	**2.52**

Table 5 – Alpha Factors

8.7.2 Weather contingency plan

If during the voyage worsening weather conditions or predictions are encountered, the tug captain shall consider the option to proceed to a sheltered area. The selection of such port of shelter will be at the discretion of Tug Captain in close consultation with the Operational Manager.

Refer to Passage planning document for detail about the route and shelter area presented in Attachment 4 & 5.

8.7.3 Report Tow Status and Towing Progress Report

The Tug Master shall record at least twice daily the convoy position and barge attitude.

A barge log shall be kept current, and a copy provided to Contractor at the completion of tow.

The document shall include:

- date and time;
- position, speed and heading;
- wind speed and direction;
- sea height and direction;
- swell height and direction;
- any unusual cargo and vessel behaviour;
- fuel used previous 24 hours;
- fuel remaining

8.7.4 Routing Assumption and Contingency Plan

In case of unexpected weather conditions and extreme emergency the tug Master shall be in contact with other tugs and/or supply vessel that, in a short reaction time can be available to assist the tow with an eventual towage in tandem or suggest port of refugee.

8.7.5 Inspection during Towage

During the voyage, the barge will be checked by sight from the tug. Barge shall be inspected following any period of adverse weather conditions.

8.7.6 Post Towage Inspection

On arrival at destination, a post towage inspection will be carried out to assess the condition of all cargo items.

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ATTACHMENT 1 –TOWING BRIDLE ARRANGEMENT & CERTIFICATES

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ATTACHMENT 2 –TUG BP CERTIFICATE AND TOW WIRE CERTIFICATE

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ATTACHMENT 3 – PASSAGE PLAN PREPARRED BY TUG MASTER

ATTACHMENT 5– PORT OF REFUGEE / SHELTER AREA (if req'd)