IDEA - IRL

INTEGRATED DESIGN OF FLOATING WIND ARRAYS IRELAND

Reference Site Technical Report E: Port Infrastructure Requirements

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[1] https://iea-wind.org/task49/

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1 Introduction

This Technical Note has been prepared by the IDEA-IRL project as one of the deliverables for work package (WP) 1 of the project, and initially as an input to the IEA Wind Task 49 Reference Site Conditions for Floating Wind Arrays Report. It primarily serves as an Appendix to the WP1 D1 Summary Report, with further context given in the summary report [1].

Ports will play a key role in all development phases involved in a Floating Offshore Wind Farm (FOWF) project, being the link between land-based activities and marine operations. The objective of this report is to provide general information about the main requirements that a port should comply with to provide a satisfactory service during the FOWF construction.

Note that these requirements are indicative only and a detailed and site-specific study shall be performed in the early stages of the project, to define requirements.

2 Key Assumptions

2.1 Type of Floating Foundations

Port site requirements are dependent on the floating foundation/substructure typology, which will determine the necessities in relation to manufacturer, assembly and staging port facilities. The main floater typologies are presented in Figure 2-1.

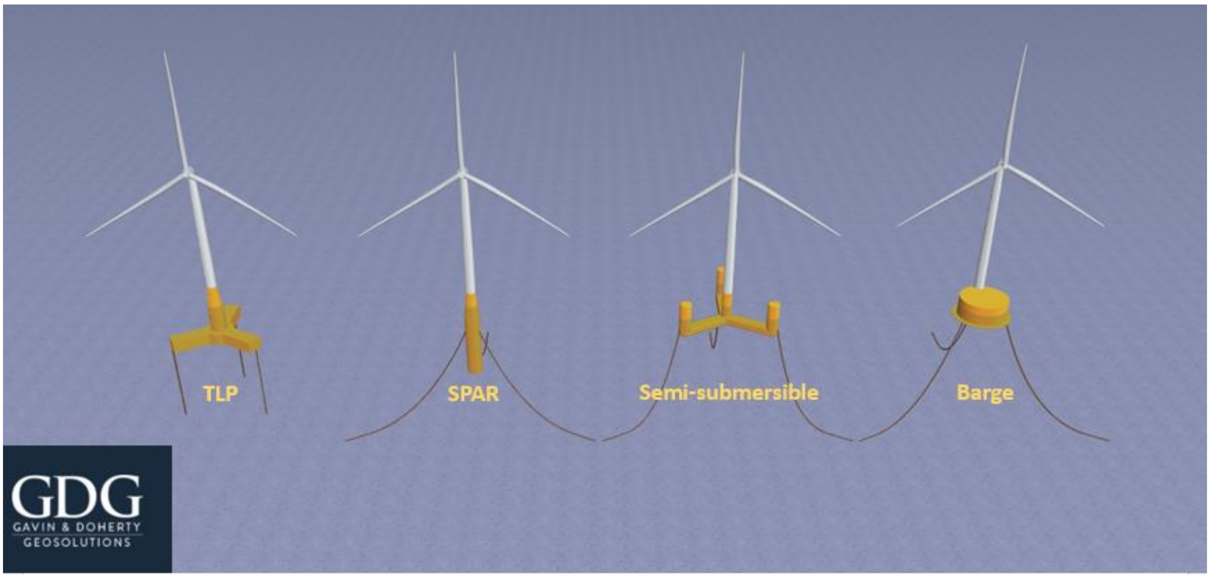

Figure 2-1: Typical Floating Foundation Types

1. **Tension Leg Platform (TLP)** type floaters are the least developed of all the floating wind substructure types, with significant research and development currently ongoing to advance the technology. They are smaller and lighter floating foundations associated with a higher buoyancy force, which require fully-tensioned anchoring mooring lines to guarantee stability. TLPs have a shallow draught and experience high vertical loads on the mooring lines and anchor due the high buoyancy.

2. **SPAR or buoy spar** consists of a cylinder structure that is stabilised by keeping the centre of gravity below the centre of buoyancy using a ballast made of one or various heavy materials. It is the substructure with the largest draught (between 70-90 m), which makes the structure less responsive to wind, wave and current. The floater is fixed to the seabed using catenary, semi-taut or taut mooring lines.

3. **Semi-submergible foundations** consist of a hull with columns connected to each other with bracings. This floater stability is provided by a combination of buoyancy (waterplane area) and ballast. The most common steel designs use three columns, of which one supports the turbine either in the centre or in a corner. There are semi-subs prototypes that are evaluating the possibility of accommodating several turbines in one platform. The substructure is anchored to the seabed by using catenary, semi-taut or taut moorings.

4. **Barge foundation** type consists of a steel or concrete hull, with stability is provided through its buoyancy (waterplane area). These foundations have a low draught, making them suitable for shallow waters if required. The structure is fixed to the seabed by using catenary, semi-taut or taut moorings.

Floating foundations are usually manufactured and assembled onshore, to be later towed to the integration port for the installation of the wind turbines. It should be highlighted that the installation of wind turbines on spar floaters might be performed offshore (as is done for fixed-bottom offshore wind) due to the draft requirements for these specific foundations.

At the moment, steel semi-sub floaters are the most popular solution for planned commercial developments, however; the optimal technology is still undecided. Therefore, unless a site has extensive prior experience with a specific solution, it should be recommended that any port development should be performed considering different floating foundation solutions in order to be flexible to future market demands. Note that, even though port infrastructure is to some extent similar for concrete and steel solutions, the requirements for concrete manufacturing facilities are slightly more demanding in terms of bearing capacity at berth. This potentially makes it more feasible to convert concrete facilities into steel assembly ports if required [2].

2.2 Key Vessels for Construction and Installation

The typical vessel categories used in the construction of a typical FOWF are presented in Table 2-1.

Table 2-1: Typical Vessels Used in FOWF Construction

Vessel Category [3]	Activities	Vessel Type	Vessel Particulars
Component Transfer Vessel[(1)(2)] (Refer to Appendix A - Reference Vessel Particulars for HLV's & General Cargo Vessels)	Import of Wind Turbine Generator (WTG) components to the staging port and transport of mooring equipment to installation site or to an intermediate staging port. These vessels can be equipped with Heavy Lift Cranes that can be used for offloading operations, however; in some occasions they consist of open deck cargo ships that require cranes on deck or the use of Self-propelled modular transporter (SPMT) modules ("ro-ro operations").	Heavy-lift vessels (HLVs), general cargo vessels, barges or coasters.	Length overall (LOA): [100 – 204] m Beam: [15 – 43] m Draft: [5.25 – 13] m *E.g.: Star Lysefjord, Zhi Xian Zhi Xing, SAL 171, etc.*
Floaters Transport[(1)]	Transport of modular substructure elements or fully assembled substructures to either assembly or staging ports. Given the significant submerged draft, fully assembled substructures may need to be floated-off in deep water and towed either into the staging port or to wet storage facilities.	Semi-sub HLVs	LOA: [134 – 275] m Beam: [36 – 68] m Draft: [9 – 11] m *E.g.: BOKA Vanguard, COSCO 68 - Xin Guang Huz, SAL MV Sun Rise, etc.*
Anchor Handling Tug Supply Vessel (AHTS)	Used for towing fully assembled units from deeper water into staging ports, and for towing fully assembled units from the staging port to the installation site. Vessels also used for the installation of mooring equipment for floaters.	Specialist anchor handling tug	Beam = 18.50m Length Overall = 77.0m Draft = 7.00m *E.g.: AHTS Bourbon Orca*
Tug Vessels[(3)]	Used alongside AHTS in towing of fully assembled units to ensure motions are limited during transit, as well as during approaching and departure manoeuvre of the component transfer vessels to guarantee complete control of the vessel. *Note that tug requirements are generally required by Port Authorities depending on vessel type and size.*	Tug Vessel	Beam = 27.00m Length Overall = 140.00m Draft = 6.85m *E.g.: Boskalis Boka Ocean*
Cable Installation Vessels (CIV)	Floating wind turbines will require dynamic cables to support export in addition to the typical buried cables associated with fixed-bottom installations. It is anticipated that cables will be transferred directly to the installation site, and as such there is no requirement for the staging port to accommodate these types of vessels.	Specialist cable installation vessels	Beam = 32.00m Length Overall = 138.00m Draft = 7.30m *E.g.: Jan de Nul Isaac Newton*

Notes:
1) Main vessel parameters are defined by a range of values due the variability of vessel sizes within this vessel typology. Refer to Appendix A for the list of Component Transfer Vessels used as a reference in this analysis.
2) As a conservative approach, only general cargo vessels and HLVs have been considered for the definition of vessels main particulars as they are associated with larger dimensions in general.
3) Tug vessels parameters are dependent on tug availability in the Port site/s considered during the construction of the FOWF.

3 Port Requirements

The general port requirements for FOWF construction are presented in this section. The present assessment is mainly focused on the distance from the Floating Offshore Wind Farm (FOWF), navigation requirements, quay length, storage areas and port services in general.

The objective of this document is to provide a general overview and some reference values of the requirements that a port should comply with in order to be considered for the construction of an FOWF. These requirements are indicative only and an existing port that is not initially compliant with all of them might be a feasible solution as real necessities are very site specific.

Note that the port requirements presented in this document are based on the existing available information and shall be reviewed as more floating offshore projects are developed in a commercial scale and more detailed information becomes available.

3.1 Distance to the FOWF

3.1.1 Integration Port

Proximity between the FOWF and the port facilities used for assembling and marshalling activities is critical to optimise transit times during construction as well as fleet costs. Also, it should be noted that Transport and Installation (T&I) operations are mainly driven by available weather windows, which are most accurate within 72 hours [2]. Hence, it is desirable that towing and installation operations are performed within an operating window no longer than 72 hours.

According to available literature as well as GDG experience in offshore wind projects, a distance of 150 nautical miles (n.m.) between the FOWF location and the installation site is recommended. Considering a tow speed of 3-5 knots, tow operations would take between 30 and 50 hours.

A recommended distance of 150 n.m. for T&I activities is indicative only and larger distances might be required depending on the existing port infrastructure near the project site. For example, the 2.3 MW Hywind demonstration device (spar foundation) was towed 250 n.m. to the final installation location and the WindFloat demonstration device was installed at 225 n.m. from the assembly port [4].

3.1.2 Floater Manufacturing Port

There are not specific requirements with respect to the distance between the floater manufacturing port and the integration port or the FOWF site. The location for the construction of the floating foundations will be defined based on the availability of laydown area at port / shipyards, the local supply chain and the existence of local qualified workforce.

3.1.3 Operations and Maintenance (O&M) Ports

O&M ports give continuous support services along the duration of the FOWF project. They must have the capacity to provide a quick response to the energy facility so they must be located within approximately 2 hours of vessel transit time to the farm. Considering a typical vessel speed of 20-25 knots for Crew Transfer Vessel (CTV) and the O&M mothership, a maximum distance of 40 n.m. is recommended between the OWF and the O&M Port [4].

3.2 Navigation Areas

Ports utilised in the different activities involved in the FOWF construction shall guarantee the availability of navigation areas suitable to accommodate the design fleet expected in the FOWF project. These navigation areas are referred to below:

- Access channel
- Turning basin
- Waiting anchorage areas

All navigation routes within the port shall be supplied with Aid to Navigation (AtoN) devices compliant with The International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) requirements.

The indicative navigation area requirements discussed below are defined based on PIANC 121 "Harbour Approach Channels - Design Guidelines" [5] considering a single lane channel and moderate environmental conditions. A more detailed and site-specific assessment shall be performed for a particular project, which can include the completion of specific navigation simulations (Fast Time or/and Real Time Simulations).

3.2.1 Access Channel

The access routes are mainly defined by the channel width and water depth, as discussed in further detail below.

Channel width is usually calculated in terms of the largest beam expected at port and it depends on several factors such as ship manoeuvrability, vessel speed, environmental conditions and existing AtoNs. According to PIANC 121 guidelines, the required channel width should be between 4 to 5 times the vessel beam (B) [5].

Ship related factors are the most important in the definition of the required water depth for safe navigation as shown in Table 3-1. Based on PIANC 121 guidelines, an Under Keel Clearance (UKC) of 10% the vessel draft would be sufficient in sheltered areas (e.g. at berth or within the port basin) whereas an UKC of 20-30% would be recommended for areas exposed to moderate swell.

Table 3-1: Channel Depth Components and Air Draught Clearance for Concept Design [5]

Description	Vessel Speed	Wave Conditions	Channel Bottom	Inner Channel	Outer Channel
Ship Related Factors F_s					
Depth *h*	≤ 10 kts	None		1.10 *T*	
	10 - 15 kts			1.12 *T*	
	> 15 kts			1.15 *T*	
	All	Low swell (H_s < 1 m)			1.15 *T* to 1.2 *T*
		Moderate swell (1 m < H_s < 2 m)			1.2 *T* to 1.3 *T*
		Heavy swell (H_s > 2 m)			1.3 *T* to 1.4 *T*
	Add for Channel Bottom Type				
	All	All	Mud	None	None
			Sand/clay	0.4 m	0.5 m
			Rock/coral	0.6 m	1.0 m
Air Draught Clearance (ADC)					
ADC	All	All		0.05 H_{st}	0.05 H_{st} + 0.4 *T*

Notes:
1. For Ship Related Factors: Assumes *T* > 10 m. If *T* < 10 m, use value for *T* = 10m
2. Swell means waves with peak periods T_p greater than 10 s
3. For Outer Channel swell values, use lower value for smaller swell wave periods and higher value for larger swell periods
4. Value of significant wave height H_s is dependent on required operation, design ship type, level of accessibility, wave period and relative wave direction
5. H_{st} is the distance from the sea surface to the top of the ship
6. Seawater density assumed for *T*. Additional adjustments required if fresh water.

3.2.2 Turning Basin

The turning basin is the area where vessels are often assisted by tugs to their berths and may be turned beforehand. In an early project stage, the minimum nominal diameter of the turning basin should be two times the vessel LOA (2 x LOA) in case of tug assistance, or three times LOA (3 x LOA) in a scenario without tugs.

3.2.3 Anchorage Areas

Anchorage areas are defined by the zones where vessels drop anchor either awaiting entry into port or to undertake cargo handling, passenger transfer or other cargo operations associated with the port.

As per PIANC 121 guidelines, the anchorage area size (RA) is defined by the sum of the anchor chain length (≈5 times water depth), an anchor dragging of 30 m and the ship LOA. In terms of water depth, a minimum UKC of 10% is recommended.

3.2.4 Summary of Navigation Requirements

Table 3-2: Summary of Navigation Requirements

Port Facilities	Assumptions	Channel Width (m) (2)		Channel Water Depth (m) (3)		Turning Basin Diameter (4)		Water Depth at Berth (m) (5)	
		Min	Max	Min	Max	Min	Max	Min	Max
Integration Port	Navigation requirements driven by Component Transfer Vessels and Floaters Transport Vessels (refer to Table 2-1)	≈160 (6)	≈310 (6)	11.25 (7)	16.25 (8)	270 (10)	550 (10)	10(7)	14.3(8)
Floaters Transport	Navigation requirements driven by Small Component Transfer Vessels and Floaters Transport Vessels (refer to Table 2-1)	≈160 (6)	≈310 (6)	11.25 (7)	13.75 (9)	270 (10)	550 (10)	10(7)	12.1(9)

Notes:

(1) Navigation requirements are calculated based on the largest vessel class expected at port: component transfer vessels and floaters transport vessels (refer to Table 2-1).
(2) Channel width considering 4.5 times the vessel beam.
(3) Channel water depth estimated considering an UKC of 25% as recommended by PIANC for areas affected by swell waves (conservative scenario).
(4) Turning basin diameter estimated considering tug support (2 x LOA).
(5) Assuming an UKC of 10% as recommended by PIANC for protected waters.
(6) Value estimated based on the beam range for floaters transport vessels.
(7) Value estimated based on the lower draft range for floaters transport vessels.
(8) Value defined based on the upper draft range for component transfer vessels.
(9) Value defined based on the upper draft range for floaters transport vessels.
(10) Value defined based on the lower and upper LOA ranger for floaters transport vessels.
(11) Values have been rounded to the nearest five.

3.3 Quay Wall Length

Assuming a continuous berth line and the vessel moored alongside, the required quay wall length will be defined by the mooring layout defined for this vessel.

As per BS 6349-4 “Code of practice for design of fendering and mooring systems” [6], the typical mooring arrangement for continuous quay lines consists of mooring lines issuing at the extremities of the ship with a horizontal angle of 45^{o} with respect the berthing line (refer to stern line and head line in Figure 3-2) in combination with breast lines and spring lines with an horizontal angle of 90^{o} and 10^{o} respectively.

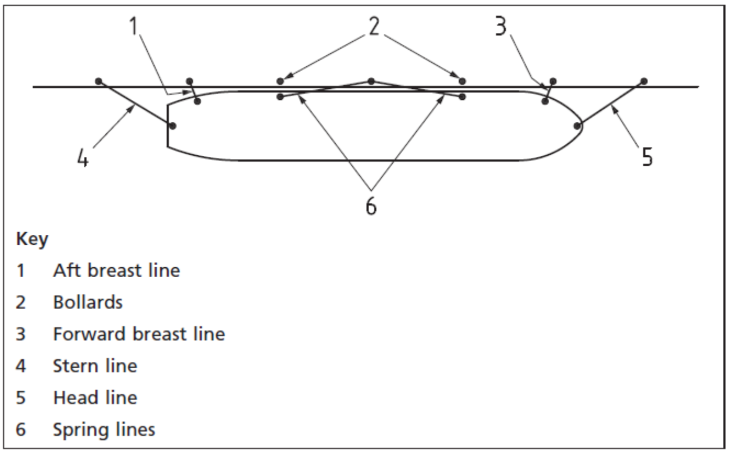

Figure 3-1: Typical Mooring Pattern for Continuous Quay [5]

As shown in Figure 3-2, the required quay wall length is therefore defined by the sum of the vessel LOA and the required quay wall length to accommodate the stern and head lines ("x" in Figure 3-2 below). Note that this value is indicative and can be refined through the completion of a "Geometrical Combability Assessment" and a "Mooring analysis" undertaken as part of initial project development.

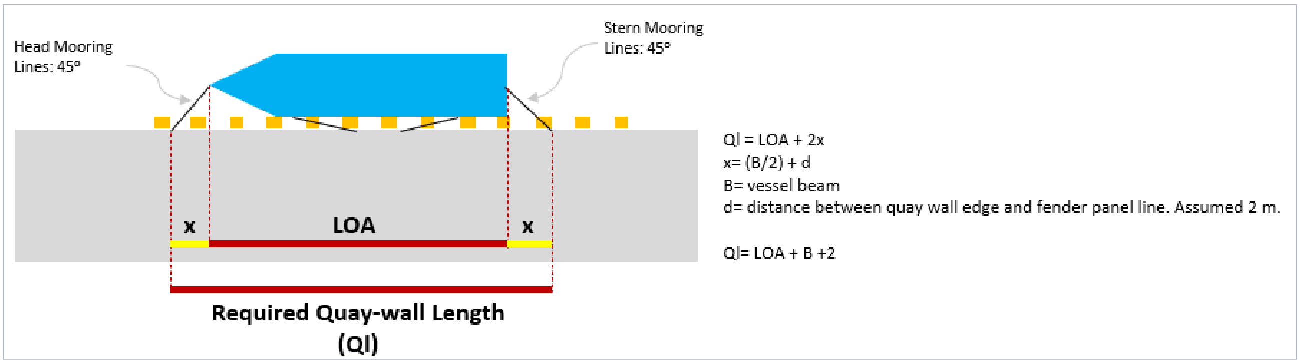

Figure 3-2: Estimation of Required Quay Wall Length by Main Vessel Categories

Table 3-3 presents the minimum and the maximum quay wall length required by a Component Transfer Vessel and a Floaters Transport Vessel. Port facilities utilised for FOWF construction might accommodate various vessels simultaneously, therefore, the total quay wall length required will be a combination of the length estimated for each vessel category.

Table 3-3: Quay Wall Length Requirements Depending on the Vessel Category

Vessel Category	Vessel Particulars (1)	Required Quay Wall Length (m)	
		Min	Max
Component Transfer Vessel	LOA: [100 – 204] m Beam: [15 – 43] m	120	240
Floaters Transport	LOA: [134 – 275] Beam: [36 – 68]	170	345

Notes:

(1) Note that the maximum LOA does not have to be associated with the maximum vessel beam. Refer to Appendix A for further detail about the vessel data considered in this assessment.

(2) Values have been rounded to the nearest five.

In a FOWF Project, quay length requirements at port will depend on various parameters such as:

- Activities undertaken at port: floaters manufacturing, wind turbine generator (WTG)component import, assembly of wind turbine on substructure, etc.
- Logistics philosophy: undertaking parallel/simultaneous activities, design fleet, number of import berths, floaters launch methodology, onshore layout, etc.

As a preliminary approach, the required quay wall length has been estimated for two different scenarios presented below:

- Integration port: facility located a reduced distance from the wind farm used to install the wind turbine on the floater. This port will also include a dedicated quay wall section for the import of WTG components as well as a dedicated onshore area for their storage.
- Floater Manufacturing port: facilities where floaters are manufactured and assembled before being transported to the integration port. This port is not required to be in the wind farm vicinity and its location usually depends on factors such as local supply chain, local experience in similar projects or Oil and Gas (O&G), existence of shipyards or dry docks at port, etc. It is assumed that this port will also include an import berth for materials, which will be transported in small general cargo vessels. Note that quay wall length requirements for manufacturing ports could be optimised with the importation of material to site by railway or road.

Table 3-4 presents the quay wall length requirements estimated for the integration port and for the floater manufacturing port.

Table 3-4: Quay Wall Length Requirements for Port Facilities

Port Facilities	Assumptions	Required Total Quay Wall Length (m)	
		Min	Max
Integration Port	Minimum scenario: • One (1) berth dedicated to import of WTG components (240m) (1) • One (1) berth dedicated to receiving floaters and to integration activities (170m) • An additional separation between dedicated berths of 20 m (area for tug assistance, safe manoeuvres, etc.) Maximum scenario: • One berth dedicated to import of WTG's components (240m) (1) • One (1) berth dedicated to receiving floaters and to integration activities (345m) • An additional separation between dedicated berths of 20 m (area for tug assistance, safe manoeuvres, etc.)	≈430	≈605
Floater Manufacturing Port	Minimum scenario: • One (1) berth dedicated to import of materials (120 m) (2) • One (1) berth dedicated to launch floaters (170 m) • An additional separation between dedicated berths of 20 m (area for tug assistance, safe manoeuvres, etc.) (20m) Maximum scenario: • One (1) berth dedicated to import of materials (120 m) (2) • One (1) berth dedicated to launch floaters (345 m) • An additional separation between dedicated berths of 20 m (area for tug assistance, safe manoeuvres, etc.) (20m)	≈310	≈485

Notes:

(1) Considering the turbines size utilised in OW, the quay wall length estimated for the import of WTG's is always estimated considering the upper bound vessel contemplated in the reference fleet shown in Table 2-1.

(2) Import of materials at floater manufacturing port is assumed to be performed by small general cargo vessels. Note that quay wall length requirements for manufacturing ports could be optimised with the importation of material to site by railway or road.

(3) Values have been rounded to the nearest five.

3.4 Storage Areas

The construction of a FOWF would require onshore laydown areas as well as wet storage areas in sheltered waters for the floating foundations storage.

Storage areas requirements are highly dependent on the wind farm capacity, turbines size, project logistics philosophy and floater typology. The values provided in this document (Table 3-5) are reference values obtained from an analysis of existing literature relating to FOWF construction and are subject to modification after the completion of more site-specific assessments required to be performed within a FOWF project.

Table 3-5: Storage Areas Requirements

Port Facilities	Activity	Required Laydown Area (Ha)	
		Min	Max
Integration Port (1)	Storage of 15-20 MW WTG components, assembly on substructure.	6	25
Floater Manufacturing Port	Floaters manufacturing and assembly (Steel or concrete)	20	40
Wet Storage	Mooring of assembled floaters at integration port and/or floater manufacturing port	4	70
O & M Activities	Continuous service to the OWF during operations.	1	4

Notes:

(1) The landside area requirements exclude storage of cable storages and mooring equipment.

3.5 Bearing Capacity

Bearing capacity requirements defined for the quayside and for the laydown areas are considered the same for the Integration Port and for the Floater Manufacturing Port as shown in Table 3-6 below.

Table 3-6: Bearing Capacity Requirements

Port Area	Required Laydown Area (Ha)	
	Min	Max
Quayside	20 (1)	50
Laydown Area	10	20

Notes:

(1) Lower values might be accepted for assembly of steel floaters.

3.6 Other Requirements

It is important that project developers agree with Port Authorities that selected port facilities will have the capacity to comply with the project requirements, contributing to a successful project completion. Apart from the requirements presented in previous sections, it will be important to guarantee that the selected port will be in a good position to provide as a minimum:

- Exclusive use of berth/s (if possible)
- Tug support and pilotage services when required (24/7 service). Two or three tugs might be required for vessel approach/departure and towing operations.
- Cranage equipment compliant with the project's logistics requirements (24/7 service).
- Qualified mooring services (24/7 service).
- Port utilities such as: power connections in the quay wall, lighting in port facilities, CCTV Security Camera Systems in the quay wall and laydown areas, communication system, etc.
- Maritime equipment in good condition and compliant with project design fleet (e.g: mooring bollards, fenders, ship to shore gangway, etc.).
- Suitable access routes (a combination of road and train infrastructure might be beneficial for import activities).

4 Summary Table

This section presents a summary of the main port requirements defined for the integration port, the floater fabrication port and for O&M activities. Note that port requirements presented in this document are based on the existing available information detailed in the references list and shall be reviewed as more floating offshore projects are developed in a commercial scale and more detailed information become available.

A port site screening shall be performed in early stages of a floating offshore wind project based on project-specific parameters such as project location, WTG size, floater typology, T&I philosophy, etc.

Table 4-1: Port Requirements for the Integration Port

Parameter	Min	Max
Distance to FOWF (n.m)	-	150
Channel Width (m)	160	310
Channel Depth (m)	11.25	16.25
Air Draft (m)	Unrestricted	Unrestricted
Turning Basin Diameter (m)	270	550
Water Depth at Berth (m)	10	14.3
Quay Wall Length (m)	≈430	≈600
Laydown Area (ha)	6	25
Wet Storage Area in Sheltered Waters (ha)	4	70
Bearing Capacity at Quayside (t/m^2)	20	50
Bearing Capacity at Laydown Area (t/m^2)	10	20

Table 4-2: Port Requirements for the Floater Manufacturing Port

Parameter	Min	Max
Distance to FOWF (n.m)	Unlimited	Unlimited
Channel Width (m)	160	310
Channel Depth (m)	11.25	13.75
Air Draft (m)	50	-
Turning Basin Diameter (m)	270	550
Water Depth at Berth (m)	10	12.1
Quay Wall Length (m)	≈310	≈485
Laydown Area (ha)	20	40
Wet Storage Area in Sheltered Waters (ha)	4	70
Bearing Capacity at Quayside (t/m^2)	20	50
Bearing Capacity at Laydown Area (t/m^2)	10	20

Table 4-3: Port Requirements for O&M Port

Parameter	Min	Max
Distance to OWF (n.m)	-	40
Laydown Area (Ha)	1	4

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Appendix A - Reference Vessel Particulars for HLV's & General Cargo Vessels

Vessel Name	LOA [m]	Beam [m]	Draft [m]	DWT (tons)
STAR LYSEFJORD	204.4	32.26	12.7	
62K Type	201.8	32.36	13.3	61,800
ZHI YUAN KOU	195.2	41.5	8.8	38,000
A- Class Vessels	193.9	28.2	11.2	31,000
MPV CLIO	192.9	27.8		
MPV URANIA	192.9	27.8		
TIAN FU	190	28.5	11	
Tian Type	189.99	28.5	11	38,100
Da Type III	179.57	28	9.2	28,000
W - Class Vessels	179.5	28	10.8	32,387
Song Type 2	179.5	27.2	10.2	27,000
BIG ROLL - MC CLASS	173	42	6.5	20,675
MC-Class	173	42	6.5	20,675
Happy P-Type	168.68	25.43	9.5	20,100
Da Type II	166.5	27.4	10.1	28,450
OCEAN GLOBE	166.15	22.9	9.8	
171	166.15	22.9	9.8	19,100
MV UHL PARTNER	166	22.9	9.5	
800	166	22.9	9.5	19,100
BIG ROLL BERING/BEAUFORT	162.8	42	6.5	
COMBI DOCK I	162.3	25.4	6.6	
Combi Dock Type	162.3	25.4	6.6	10,500
183	160.6	27.91	9.01	12,501
ZHI XIAN ZHI XING	160	43	6.8	
G-Class Vessels	159.99	27.4	9.8	25,734
176	159.8	24.34	9	12,000
Happy D-type	156.93	25.6	10.32	17,518
Happy S-type	155.97	29	9.5	19,000
Happy Sky	154.8	26.5	9.5	17,775
BBC Amber	153.44	23.2	11.95	
CY-Class	152.64	40	5.52	15,630
K3000	152.6	27.4	8.65	14,000
161B	151.67	21.02	7.85	8,900
161A	151.67	21.02	7.85	9,370
161	151.67	20.65	7.85	9,544
ST Class	151.5	25.4	5.67	
MV UHL FAITH	150	25.9	8.3	
F900	149.99	25.6	8.3	16,729
SERVANT	147	22.8	8.1	12,301
STELLAR MAESTRO	146.25	20.2		
BIG ROLL - BISCAY	146	28	5.25	12,285

Vessel Name	LOA [m]	Beam [m]	Draft [m]	DWT (tons)
Happy Buccaneer	145.89	28.3	8.24	13,740
FWN RAPIDE	145.63	18.25		
J1800	144.1	26.7	8.1	13,017
S Class	142	24	5.67	
160	139.99	21.5	8.2	12,346
Happy R-Type	138	22.88	9.5	15,634
INDUSTRIAL RUBY	134.52	21.84		
116	133	23	7.8	10,000
VECTIS PROGRESS	123.96	17		10,234
INDUSTRIAL EMMA	122.45	18.4	7.15	7,700
AURORA	119.98	15		
BOTHNIA	119.98	15		
CHARGER	119.8	20	7.72	8,034
CHALLENGER	119.8	20	7.72	8,034
INDUSTRIAL CHARGER	119.8	20	7.72	8,034
INDUSTRIAL CHALLENGER	119.8	20	7.72	8,034
INDUSTRIAL HOBART	118.55	15.2	7.05	7,778
FWN MOMENTUM	116.26	17.8		
MERCHANT	116.26	17.8		
H800	110.49	20.85	7.7	7,051
INDUSTRIAL COLOR	99.99	20.5	8.3	8,400
INDUSTRIAL CONFIDENCE	99.99	20.5	8.3	8,400
INDUSTRIAL CONSTANT	99.99	20.5	8.3	8,400
INDUSTRIAL COURAGE	99.99	20.5	8.3	8,400
ACE	99.92	17	7.28	6,265
AMA	99.92	17	7.28	6,265
INDUSTRIAL AIM	99.92	17	7.28	6,265