4. FLOATING OFFSHORE WIND PORT CRITERIA

4.1 General

The items listed below comprise the required criteria for a floating OSW port capable of fabricating the foundations, moving the foundations into the waterway, and installing the WTG components on top of the foundations.

As noted in Section 17 below, it should be noted that there are currently no purpose designed and built ports to support the floating OSW industry anywhere in the world. Accordingly, this required that we make assumptions based upon our knowledge of the fixed and floating OSW requirements. Although we feel these assumptions are valid, we must acknowledge that our conclusions and design is conceptual and is based upon the best available information at this time. They may require adjustments as this industry continues to develop, environmental and other conditions are more fully considered, and the preliminary design continues.

Under this scenario the raw materials for the foundation fabrication are delivered to the site via road, rail, and/or the quay. These materials are then used to fabricate the foundations at the port site. The WTG components are delivered to the terminal via bulk carrier vessel and/or barge. Consistent with the few floating OSW facilities launched to date, this concept design envisions that the foundations are transferred to the waterway via a semi-submersible barge. The WTG components are installed atop the foundation. Once the floating turbine is complete it is connected to tug boats and towed to the installation site.

4.2 Design Vessels and Required Draft

The vessels expected to call on the proposed port facility will consist of delivery and installation vessels. Delivery vessels will consist of bulk carriers and/or barges bringing both the foundation raw materials and WTG components to the site. The barges will allow for roll-on/roll-off (RORO) delivery operations. The install vessels are assumed to be purpose-built semi-submersible barges. These barges will be used to transfer the finished foundations from quayside to the waterway. The terminal berths should be designed to safely berth, moor, and load/unload vessels consisting of the magnitude of the parameters presented in Table 4-1 through Table 4-3.

For the purposes of this project, the following vessels were used as design vessels:

- Installation Vessel: Purpose-built (or modified) semi-submersible barge
- Bulk Delivery Vessel: Large bulk carrier (ex: SAL Type 183)
- Barge Delivery Vessel: Crowley 455 Series Barge

Table 4-1: Install Design Vessel Parameters

Purpose-built Semi-sub	Feet (meters)
Length overall	400 (122)
Beam	400 (122)
Draft	25.0 (7.6)

Table 4-2: Delivery Bulk Vessel Design Parameters

Item	Feet (meters)
Length overall	525-607 (160-185)
Beam	82-92 (25-28)
Draft	26-32 (8-10)

Table 4-3: Delivery Barge Design Parameters

Crowley 455 Series Barge	Feet (meters)
Length overall	400 (122)
Beam	105 (32)
Draft	19 (5.8)

The fabricated foundation will be required to float next to and be moored at the berth during the installation of the WTG components. The exact draft of different foundation systems is proprietary information and is, therefore, unknown. M&N has had discussions with one developer who reported that their foundation will require 25 to 30 ft of water at the berth. For the purposes of this study, it is assumed that the water required for the foundation at the berth will be no deeper than 35 ft mean lower low water (MLLW).

Typical international standards call for vessel under-keel clearance allowance of 10% of the draft in sheltered conditions and up to 15% of the draft in more exposed conditions, both along the approaches to the berth and at the berth pocket area. The minimum required water depth is, therefore, elevation -35 feet MLLW for the navigation channel, site approach channel, and berth. This considers the deepest drafting design vessels coupled with required under-keel clearance.

4.3 Vessel Clearances

The minimum clearance separation distance between vessels is proposed to be a minimum of 75 ft (22.9 m).

4.4 Uplands and Quay Area

A relatively-level uplands and quay area is required at or near deep water access to provide enough space to fabricate the foundations and transport them to the quayside. Space is also required for the storage and staging of the WTG components. Estimated required areas consist of:

- Phase 1: 40 acres
- Phase 2: 65 acres

The acreage of both Phase 1 and Phase 2 should be considered an estimate based on similar requirements in the fixed foundation OSW industry. As discussed above, there have been no commercial scale floating OSW installations anywhere in the world to date. These required areas can be adjusted as the industry develops, environmental and other conditions are more fully considered, and the preliminary design continues.

4.5 Loading Criteria

Based on the assumed activities, the loading criteria has been divided into the uplands and the heavy lift area directly behind the quay. The loading levels were set based on similar activities in the fixed foundation OSW market.

Both the WTG component and fabricated foundation movement at the facility is assumed to be via self-propelled modular transporter (SPMT). This methodology is used extensively in the OSW industry due to its ability to handle and efficiently spread significant loads to achieve manageable applied loads on the structures below. SPMTs are built up using a series of axles that are connected together to form a "train". Each axle can support between 40 and 60 tons. If this loading level is distributed over the areas of the SPMT units in the train, the maximum applied uniform load is approximately 3000 psf. This loading level is, therefore, used as the upland criteria.

The WTG components may be preassembled in the area directly behind the quay. These preassembled components will then be lifted onto the foundation using a land-based crawler crane. These activities typically increase the loading demand significantly. Required loadings levels are:

- Uplands: 3000 psf
- Quay and Heavy Lift Area behind the Quay: 5000 psf

4.6 Air Draft

Once the WTG components are fully assembled on the foundation, the height of the unit can be approximately 700 to 800 ft from the waterline. These units are then towed out to the installation site in this finished configuration. Port sites, therefore, require unlimited air draft with direct access to open water. There can be no bridges or overhead electrical wires on the route between the port and the proposed installation site.

4.7 Length of Quay

The quay will be required to service 3 distinct activities in both Phase 1 and Phase 2.

- Delivery of WTG components and/or raw materials to the facility
- Transfer of fabricated foundation from the quay to the water via a semi-submersible barge
- Berthing of floating foundation quayside during installation of WTG components

In Phase 1 it is assumed these activities will share the same space at the berth. In Phase 2 it is assumed that each of the three activities will have a distinct place at the berth and can, therefore, occur simultaneously.

The required length of the berth is directly related to length of the vessels and foundations and the proposed spacing between the two. The relevant measurements are listed below in Table 4-4.

Table 4-4: Parameters for Required Length of Quay

Element	Length (ft)
Foundation	320
Semi-submersible barge	400
Delivery Vessel Phase 1	525
Delivery Vessel Phase 2	607
Required Spacing Between Elements	75

Required length of quay:

- Phase 1 (with mooring dolphins): 500 ft
- Phase 1 (no mooring dolphins): 625 ft
- Phase 2: 1477 ft (400+75+607+75+320)

  Actual quay length may be longer due to logistical requirements of uplands and retention of upland fill constraints.

4.8 Land-Based Crane Requirement

A large land-based crane will be required to lift and install the WTG components onto the foundation floating at the quay. The capacity of this crane must meet both the load and hook height criteria for the proposed project. For the purposes of this study the land-based crane was assumed to be a Liebherr 11350. Other smaller mobile cranes may also be used at the site.

4.9 Distance to Installation Site

The completed floating turbine units will be towed to the installation site. This tow distance will vary and has been as high as 780 nm for the Kincardine Phase 2 project. The acceptable tow distance is primarily dependent on the ability to accurately predict the weather and sea state over a distinct period of time.

A tow can be approved if the predicted weather and sea state, over the predicted length of time required for the tow, are able to meet the required environmental parameters. Currently there are no existing BOEM lease sites off the coast for Maine. However, the Searsport location offers a good, centralized location along the coast.