Floater Design and Infrastructure Requirements to Enable Industrialized Serial-fabrication on US West Coast

Thomas M Newcomb, Chief Consultant
Overview

- Ramboll
- Introduction
- Floater Design Implications on Fabrication
- Floater Design Implications on Ports
- Consideration of California Port Infrastructure
- Summary
Ramboll

- Ramboll Group: 16,500 employees
- Leading independent Consultancy in Offshore Wind with more than 300 offshore wind experts globally
- Concept and technology agnostic
- Present in all established and emerging markets
- Combining commercial excellence & offshore engineering know-how
- More than 40 commercial and R&D projects in floating wind since 2007
- Dedicated floating wind team covering FOWT specialist topics (coupled analysis, mooring, dyn. cable)
Introduction

- California Technical Offshore Wind Potential of 112 GW
- California to set a goal for offshore wind development by 2045
- Auction later this year for Humboldt and Moro Bay WEAs
Floating Wind Solutions

Floater Design Impact on Fabrication

**Large-Volume Steel Structures**
Assembled from blocks around 100-350 tons. Assembled structures will have outer dimensions of 75-100m for 15MW class. Mainly stiffened plates.

**Slender Steel Structures**
Assembled from slender (tubular) elements; “Jacket-type” structures. Different types of joints possible (welded, pins/bolts, grouted, etc.). Mainly unstiffened tubulars.

**Concrete Structures (in-situ)**
In-situ slip formed or casted in place, using mobile batching plants. Single block or few large blocks. Steel armoring & post-tensioning. Integrated steel interfaces.

**Concrete Structures (modular)**
Prefabricated concrete modules. Assembled at central assembly area. quayside; different types of joints. Integrated steel interfaces.
Design Implications on Fabrication and Logistics

Dimensions and Masses
• Implications on fabrication facilities, port, storage/buffer strategy (area, draft, crane, ground bearing, etc.)

Stability/Draft During WTG Integration and T&I
• The stability of the floater in different loading conditions and the installation process govern the quayside and on-site procedures and vessels / cranes / infrastructure required

WTG-Floater Integration Quayside vs. Offshore
• Depending on vessel availability, capacity, floater stability and weather conditions, it will have a major impact on the logistics strategy (local staging/marshalling port required or a global)
Floater Design Implication for Ports

**Floater Design**
- Floater dimension very widely across technologies
- Port assembly and towing draft is a key consideration

<table>
<thead>
<tr>
<th>General Floater Archetype (15 – 20 MW)</th>
<th>Barge</th>
<th>Spar</th>
<th>Semi-Submersible</th>
<th>TLP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outer Box Dimensions (L x B x H; excl. TP)</td>
<td>L: 55-65 m, B: 55-65 m H: 15-20 m</td>
<td>Ø: 20-25 m H: 100-140 m</td>
<td>L: 70-90 m, B: 80-100 m H: 35-40 m</td>
<td>L: 70-90 m, B: 80-100 m H: 35-55 m</td>
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<tr>
<td>Operational Draft</td>
<td>10 – 15 m</td>
<td>85 – 120 m</td>
<td>20 – 30 m</td>
<td>20 – 40 m</td>
</tr>
<tr>
<td>Port Assembly Draft (with tower &amp; WTG)</td>
<td>5 – 10 m</td>
<td>85 – 120 m</td>
<td>5 – 20 m</td>
<td>5 – 10 m</td>
</tr>
</tbody>
</table>

Generic figures provided in the table are to illustrate the large variety of dimensions between floater concepts and within each concept type.
Assembly Port Considerations

Mating & Final Assembly

Zone 2

Zone 1

Storage

Launching

Launching of assembled Floater by Launching Barge

Unloading of Sub-Blocks from transport vessel

Zone 3

Transport of assembled Floater

Transport of pre-assembled elements of Floater

Transport of Sub-Blocks

1 ha/2.47 ac

Footprint area of Floater

Legend

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The Marriott Marquis, Houston 1-3 March 2022
Existing infrastructure and supply chain in CA

Floating Wind Port Activities

- Floater Assembly
- Turbine Integration
- Fabrication of Components/Blocks
Summary

- Cost-effective commercial floating wind projects in California will require industrialized serial production.
- Floater design for California projects must consider the fabrication strategy and port infrastructure available.
- Existing California port infrastructure will require significant investment to support local offshore wind fabrication and assembly.
Thank You

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