Offshore Floating Wind Turbines - Green Electricity for O&G Platforms

Izleena Md Iqbar
Technology Manager,
PETRONAS
Green Electricity for O&G Platforms

• PETRONAS has declared its’ aspiration to achieve net zero carbon emissions by 2050.

• Challenges in Malaysia O&G operations:
  • low wind region
  • offshore ~ up to 250km from shore
  • water depths > 60m
Conventional Power Generation

- $\text{CO}_2$
- $\text{CO}_2$

Turbine Generators x3

Running
Running
Standby

HIGH CARBON TAX

HIGH MAINTENANCE

Processed Gas

LNG FACILITY

Natural Gas
Hybrid Power Generation

Lower Carbon Tax

Turbine Generators x2

Lower Maintenance

Processed Gas

Additional Sales Gas Revenue

LNG Facility

Natural Gas
Wind Turbine Components

- Wind Turbine
- Microgrid System incorporating Energy Storage System (ESS)
- Floating Platform
Advance algorithm implementation for microgrid

- State of the art WT Micrologic application – control voltage and frequency of wind turbine, ESS & conventional generator.
- Enables seamless transfer between wind turbine, ESS and conventional generator according to load demand during low or erratic wind speed condition.
- WT and GTG act as main power generation and ESS as backup power during low wind speed.
GICON® TLP

- Small footprint
- Gravity anchor
- Composite mooring lines
- Simple design
Simple TLP design (concept development)

- Combining buoyancy and tension-based stabilization which gives favorable motion characteristics compared to other floating substructure types.
- Stiff platform – activating suitable pre-tensions in the moorings. Working with high safety level and redundancy for e.g. critical components like connectors and cables.
- Smaller and lighter structure compared to others.
Current design of TLP

- manufacturing of components using existing fabrication structures of a shipyard.
Comparison TLP design 4 MW/ 10 MW wind turbine

<table>
<thead>
<tr>
<th></th>
<th>4MW</th>
<th>10MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe diameter in m</td>
<td>2.5 to 10</td>
<td>3.6 to 14.5</td>
</tr>
<tr>
<td>Pipe thickness in mm</td>
<td>20 to 35</td>
<td>30 to 50</td>
</tr>
<tr>
<td>Plate thickness in mm</td>
<td>14 to 95</td>
<td>14 to 110</td>
</tr>
</tbody>
</table>

MSL- depending on site condition
Future design of TLP (advanced simplified solution)

- Simple manufacturing of components by using existing fabrication structures:
  - Pipes made by monopile technology
  - Nodes made by casting technology

- Simple assembling of components by using plug and play connection between nodes and pipes.
Earthquake Resilient

- No major inhomogeneous liquefaction expected.
- If additional anchor settlement – adjustment of ropes feasible.
- In place stability is given.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>$F_x$</td>
<td>-4300</td>
<td>-4400</td>
<td>-6820</td>
<td>-6870</td>
</tr>
<tr>
<td>$F_y$</td>
<td>-2</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>$F_z$</td>
<td>550</td>
<td>570</td>
<td>890</td>
<td>860</td>
</tr>
</tbody>
</table>
PCIC leveraging on local supply chain

• Fabrication Yards
  • TLP
    • Experience in platform building
    • Drafts >5m
  • GA
    • Experience in pre-cast concrete
    • Space for GA at least post pan max. width
    • Drafts > 10m

• T&I
  • At least 2 Tugboats of 2200 HP with winch and winch capacity of 20 ton.
  • 1 construction vessel with ROV.
  • At least 1 ROV with lifting capacity of 1 ton and different tools.
T&I with towing tugs and ROV

- 2 step installation using towing tugs only.

- Installation by ROV, no diver intervention required.
Conclusion

• PETRONAS Floating TLP has obtained DNV AIP and ready for commercialisation.

• The applications are:
  • Reliable O&G microgrid – integration among O&G existing conventional turbine generators, wind turbine system and large energy storage system.
  • Power to grid.

• Our solution will be leveraging on local supply chain.