Large scale floating wind projects: Tension Leg Platforms & the case for offshore in-situ maintenance strategies

Floating Wind Solutions 2022

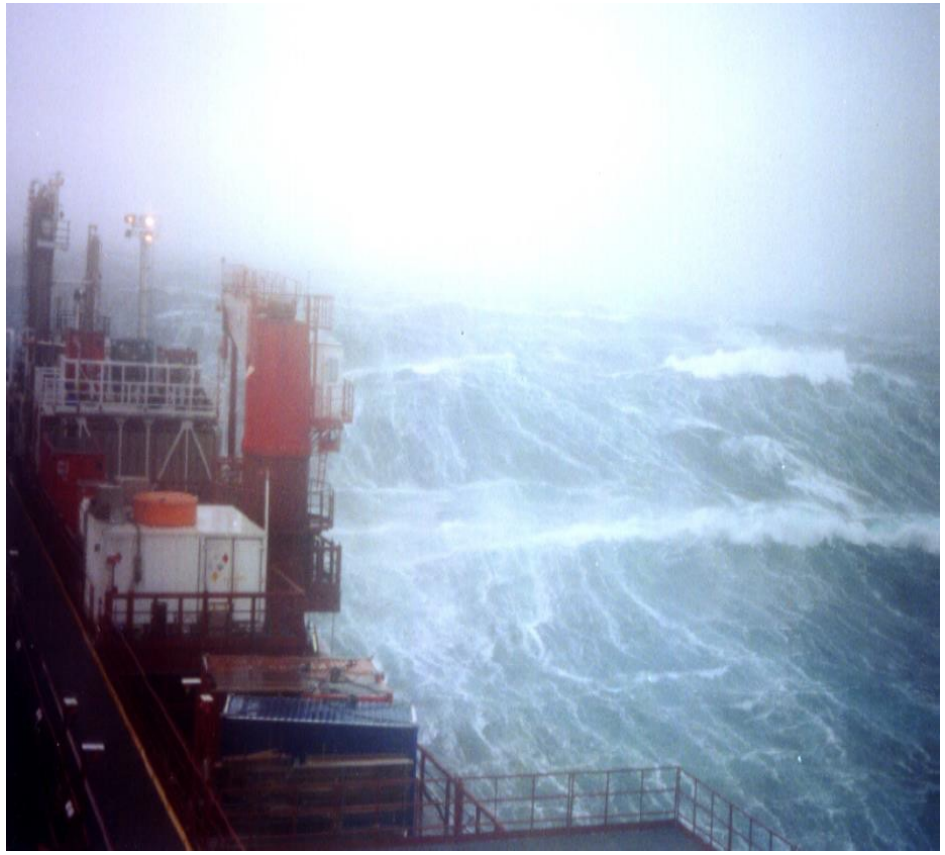
Operations & Maintenance session

3 March 2022

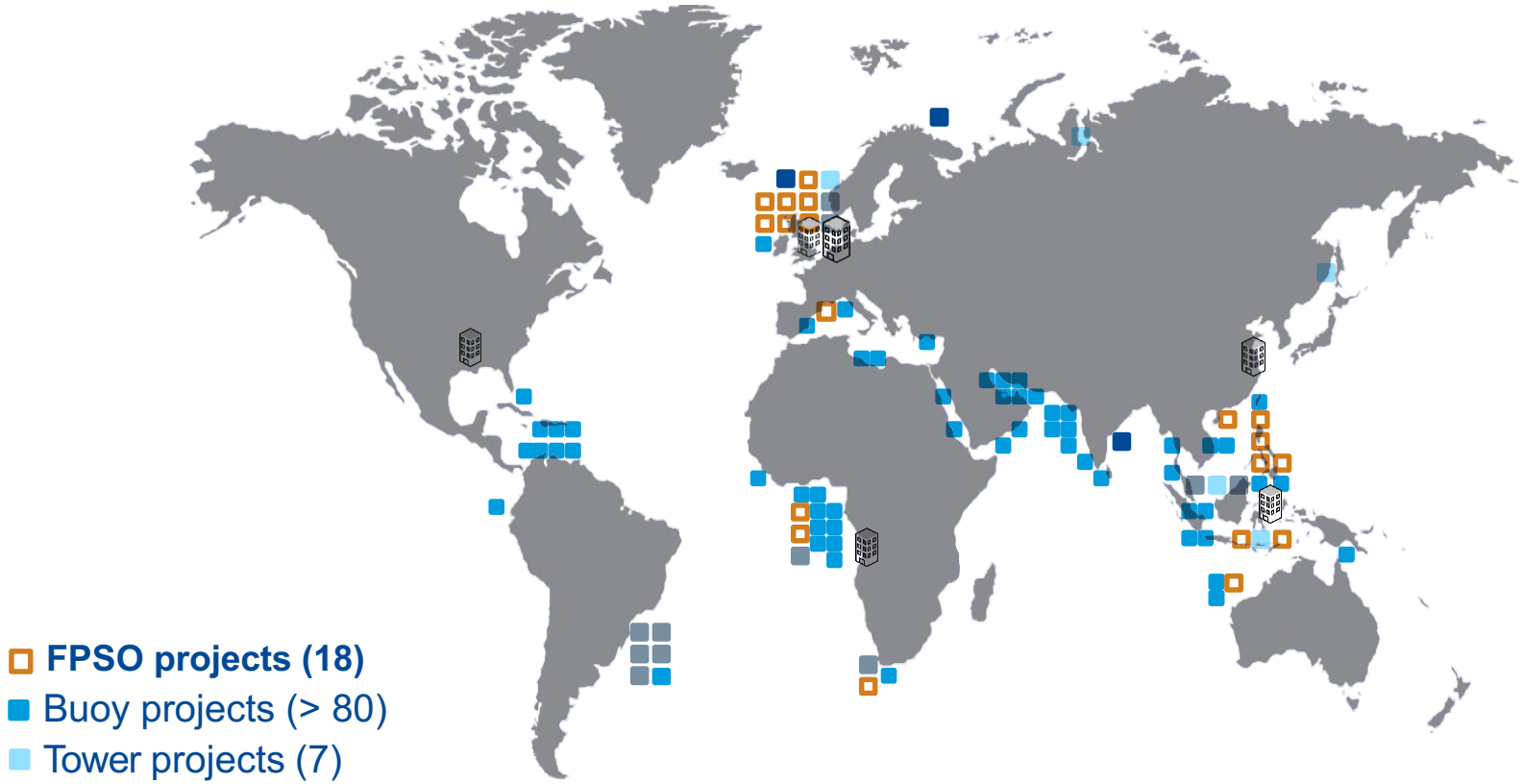
Bram Pek

Bluewater Energy Services

- Privately owned, independent group of companies founded in 1978
- 40 years of engineering and operations of permanently moored systems
- ~1000 employees (onshore & offshore)
- Owner & operator of FPSOs
- Harsh environments



Bluewater's global footprint



- **FPSO projects (18)**
- Buoy projects (> 80)
- Tower projects (7)
- Turret projects (> 20)
- Offices

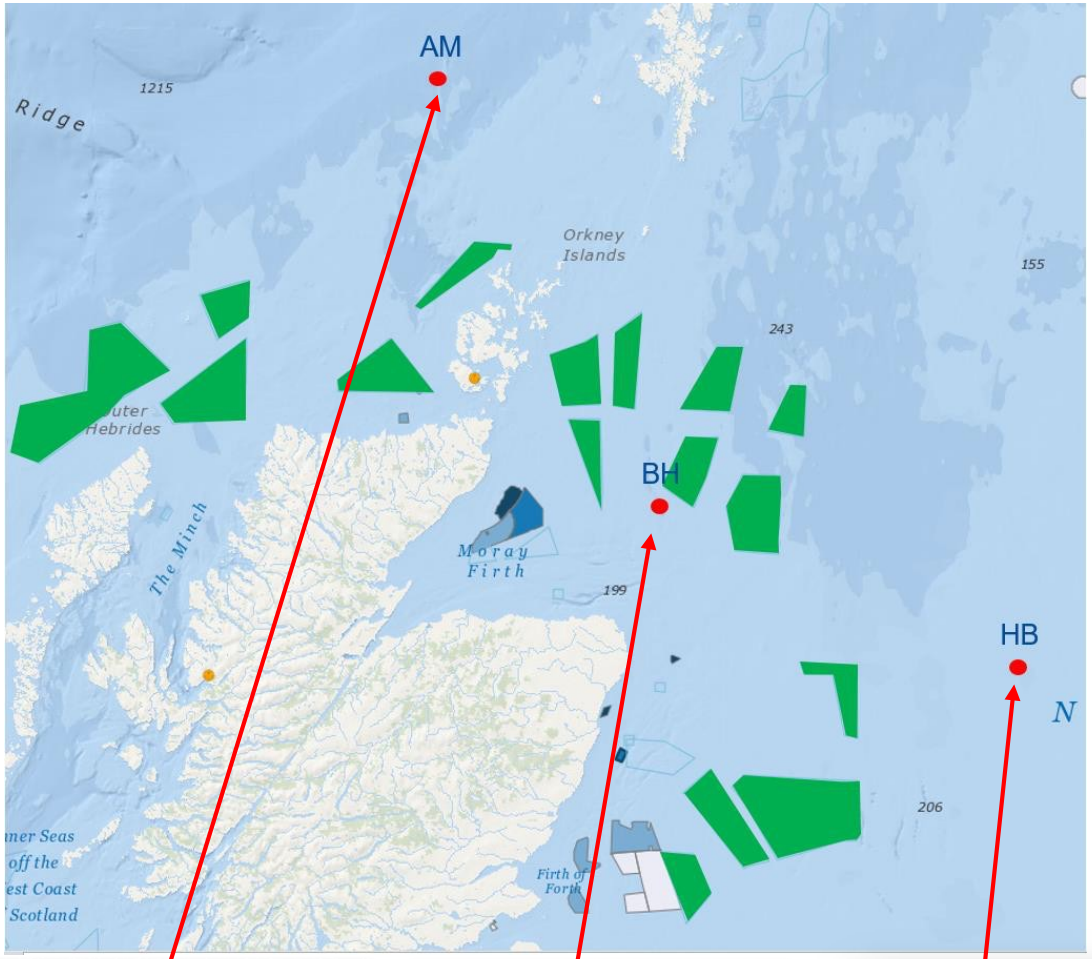
Bluewater: Design, Build & Operate

Practical Project Execution Experience

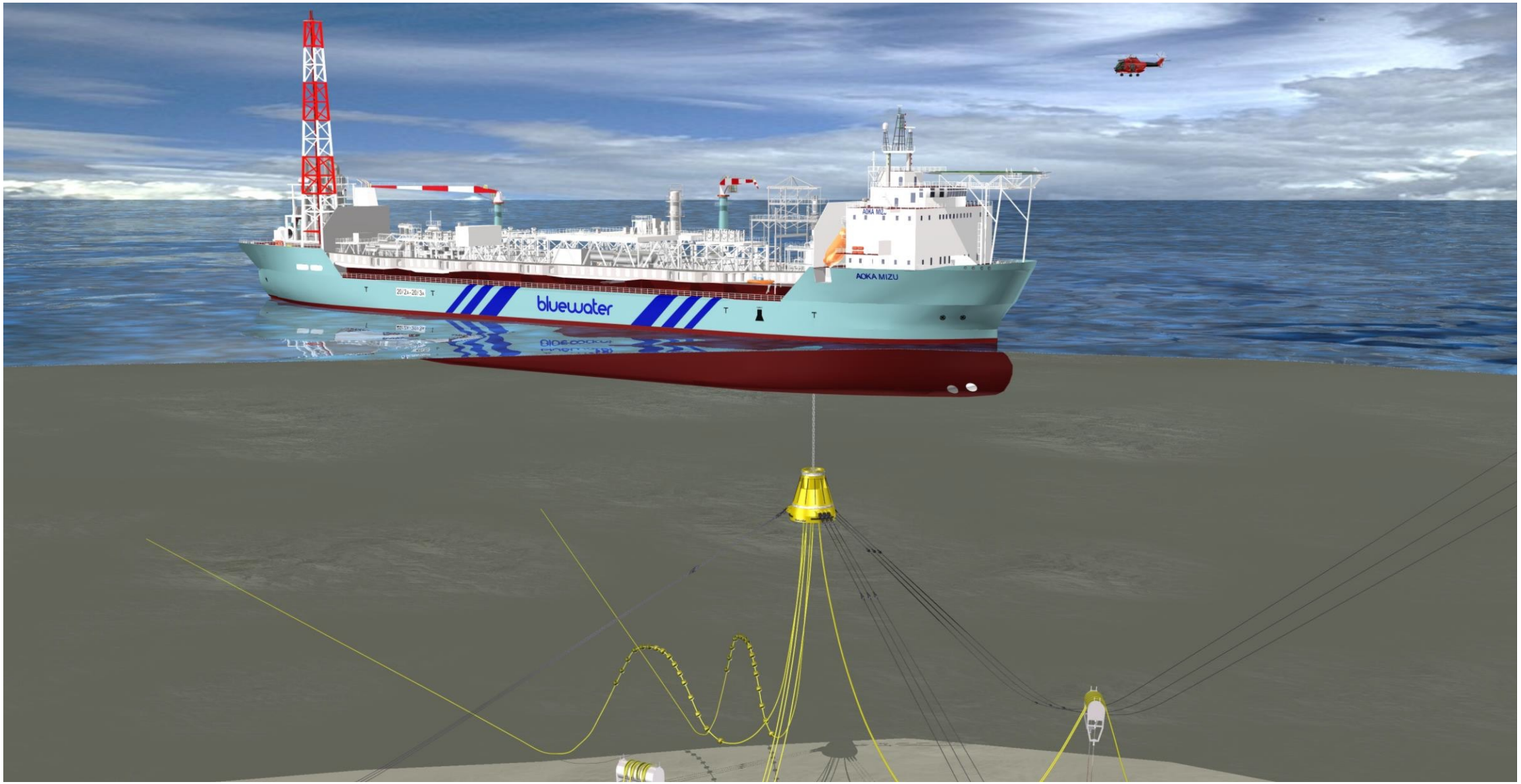
Design Build Operate

Practical Operational Experience

FPSOs in operation in Scotland



Hook-up / hook-off



Weather windows considerations

- Distances to port of planned projects are significant
- Tow-out requires long weather windows

- Year round installation becomes risky

Floating Offshore Wind TLP

- Bottom fixed wind turbines
- Lightweight floater
- Simple structure
- Offshore installation of WTG
- Deep-draft legs
- No mooring lines on the seabed
- No active ballast systems

Focus on logistics:

- Separate supply chains for WTGs and foundations to control risk
- Learnings from bottom fixed projects

Separate supply chains

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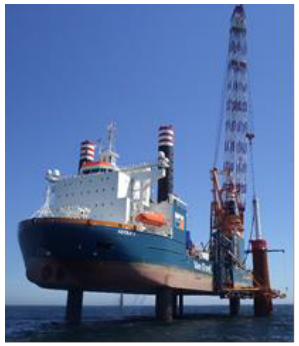
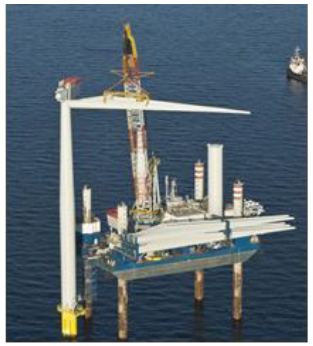
Foundations

WTGs

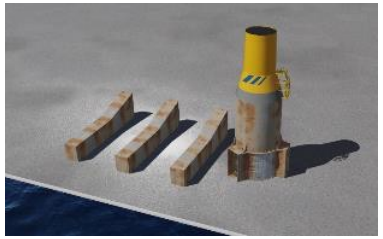




foundation → transition → tower → nacelle → 3# blades

Installation campaign #1

Installation campaign #2



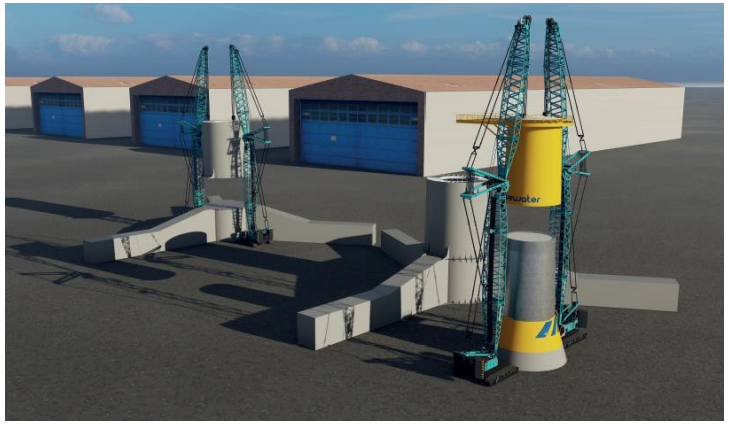
foundation → transition → tower → nacelle → 3# blades

Installation campaign #1

Installation campaign #2

Impact on ports logistics

- Port congestion avoided
- Wet storage not required
- Efficient use of quayside for storage of TLPs
- Simple assembly of modules



TLP storage

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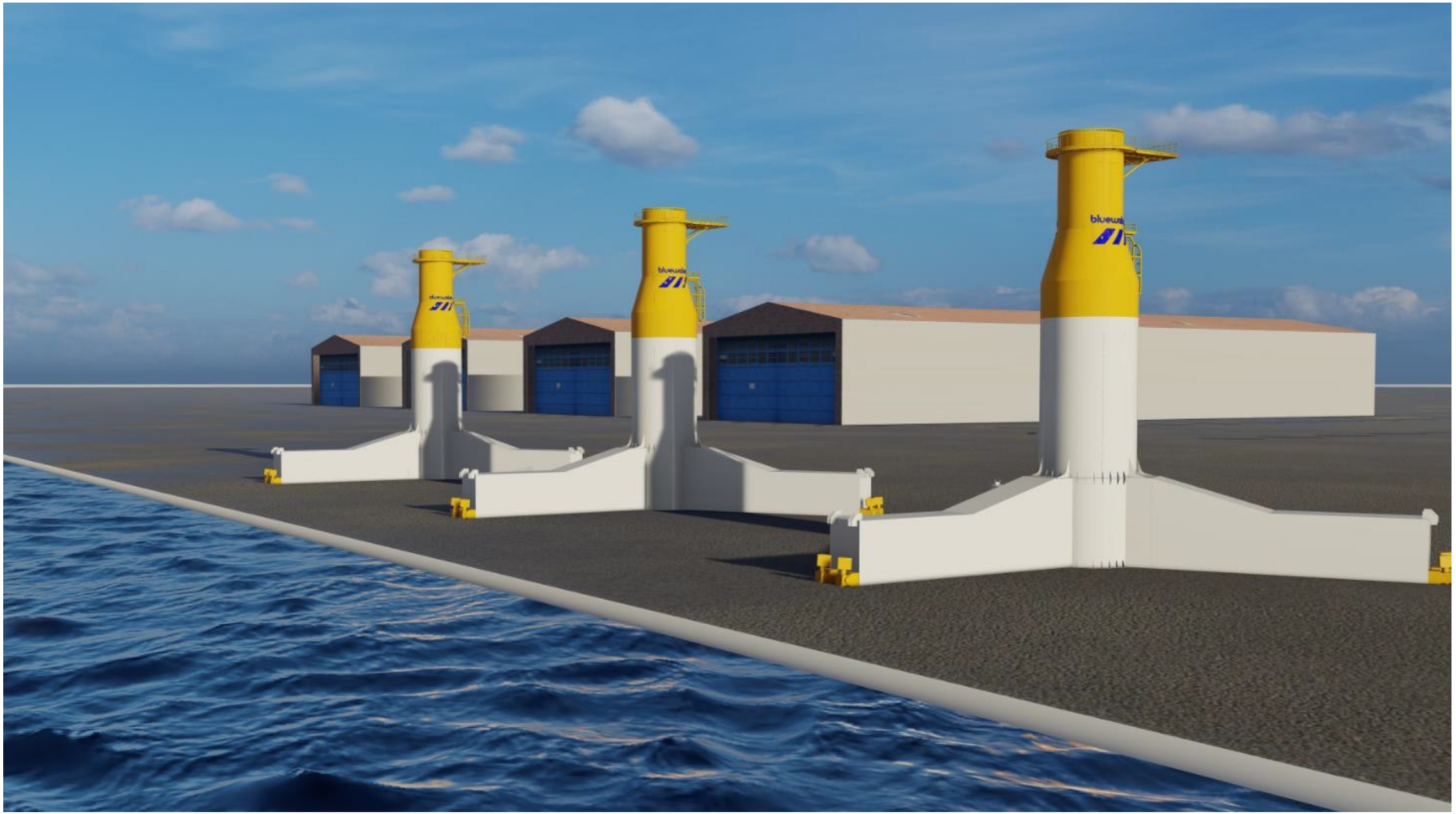

Pre-installation of floating foundations

Pre-installation of floating foundations

Floating installation of WTGs

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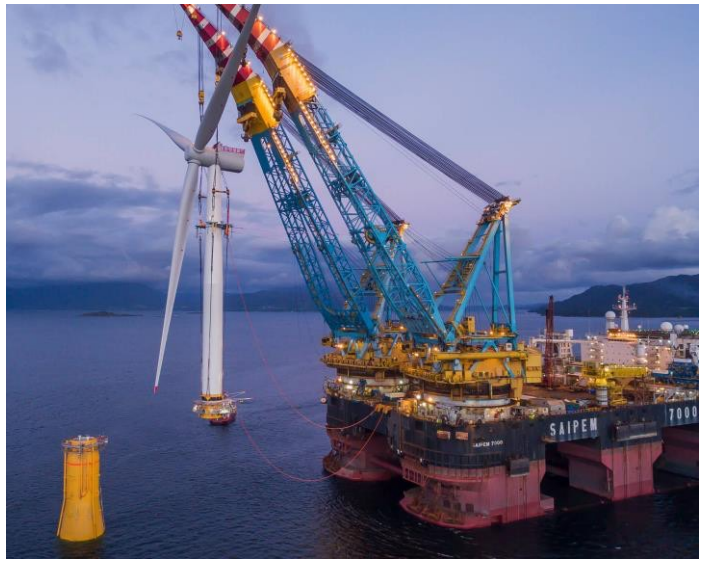

Floating-to-floating WTG installation

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New floating WTG installation concepts

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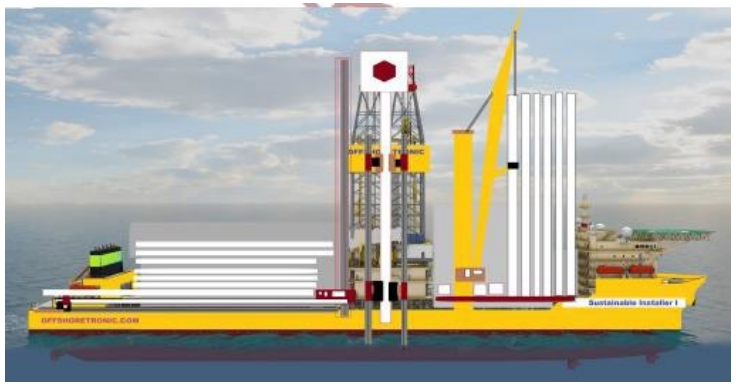

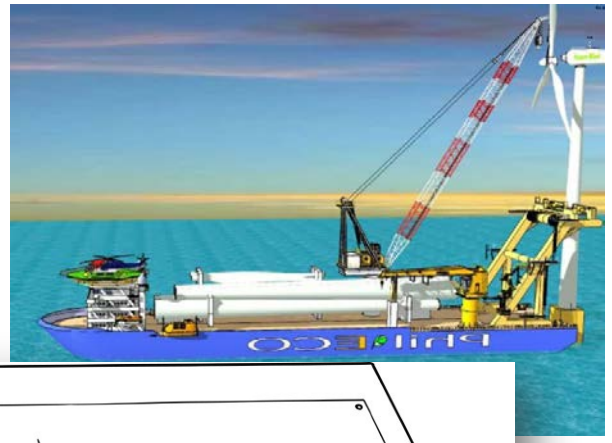

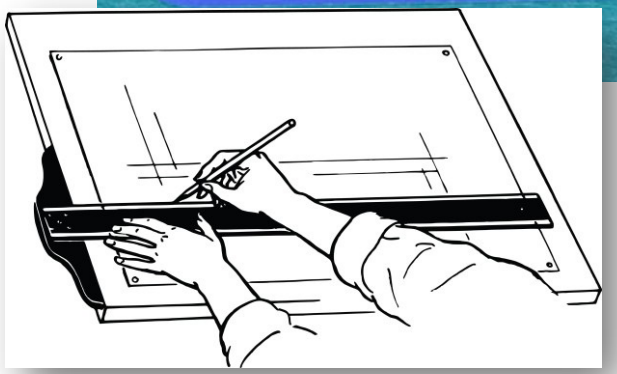

Quick connection method

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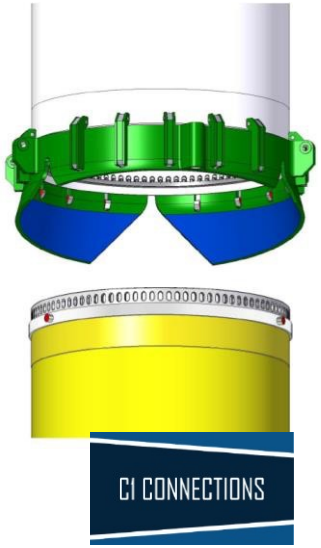
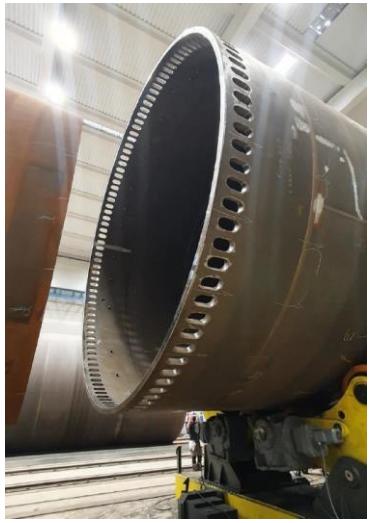
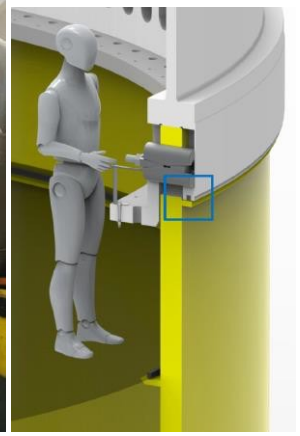
Single slip joint

Double slip joint

Wedge connection







alternative
solutions blade
flange connection

Tow-out vs offshore build-up

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For non-sheltered floating wind sites

tow-out

pro's

- low cost solution for 1 off
- cost effective for short distance to port

con's

- stability required during tow to avoid WTG accelerations
- weather downtimes for long towing distances
- hook-up / hook-off high risk
- crane operations required in port

offshore build-up

pro's

- year-round installation of foundations & WTGs
- optimized supply chains
- efficient for large scale parks

con's

- offshore in-situ maintenance strategies required

Bottom fixed offshore wind maintenance

Offshore in-situ blade exchange

- Connect maintenance vessel to TLP on Dynamic Positioning, removing horizontal relative moments
- Heave compensation tooling, removing, vertical relative motions

Seaqualize tool In-hook Balanced Heave Compensation

Forward looking weather systems

Only short timeframes required for installation & maintenance activities

Several solutions available in the market

- Forecasting of environmental conditions
- Prediction of weather conditions 4 – 5 minutes
- Forecasting of metocean conditions can be refined using hindcasts

In-situ maintenance crane

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Deployable crane for in-situ blade & component change out

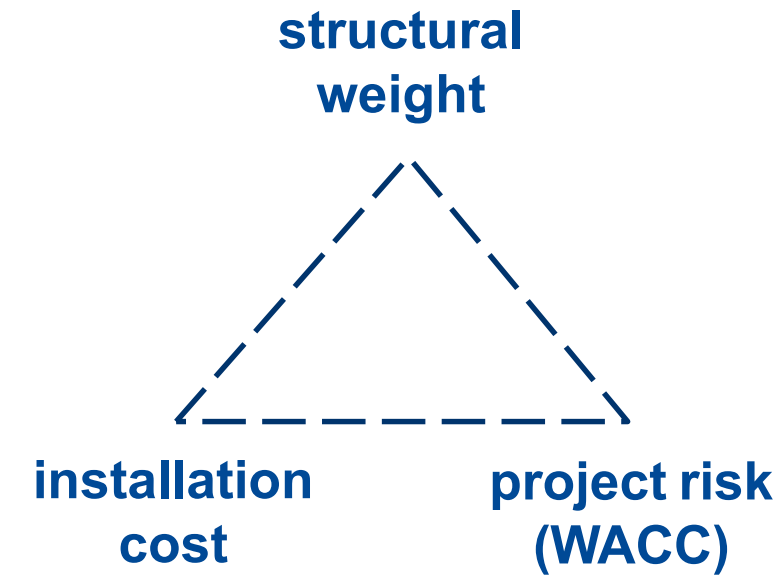
- Mounted on the floating foundation
- No heavy crane supports in nacelle or around tower
- No relative motions during maintenance
- Self erecting crane
- Support ring around tower for horizontal stability only

Conclusion

1. Tow-out of FOW systems is risky, in particular in harsh sites

2. LCOE main drivers trade-off

3. In-situ maintenance solutions need to be developed now



Q & A

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