MOORING OPTIMISATION CASE STUDY

(WP7-D4)

August 2024

PROJECT OVERVIEW

- 1GW floating wind project
    - 67 floating platforms
    - WTG – NREL 15MW
    - Platform – ACTIVEFLOAT Semi submersible (15MW)
- This case study explores how the introduction of an innovative mooring component, the Load Reduction Device (LRD), led to a significant reduction in the capital expenditure (CAPEX) for the mooring system.

SITE CONDITIONS

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Distance to Port 50km

Water Depth - 100m

Wave Height – 11.5m Hs (50yRP)

Mean Wind Speed – 10 m/s

15MW NREL Wind Turbine

‘ACTIVEFLOAT’ Semi-Submersible (CoreWind)

ANALYSIS SUMMARY

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System Types	No. of mooring configurations	2
DLC6.1	No. Load Cases	12
	No. Seeds	1
	Analysis duration (sec)	10800
	Metocean Direction	Site specific directionality
DLC1.2	No. Cases	15
	No. Seeds	1
	Analysis duration (sec)	600
	Metocean Direction	Aligned with primary fairlead
DLC1.6	No. Cases	9
	No. Seeds	1
	Analysis duration (sec)	3600
	Metocean Direction	Site specific directionality
IEC 61400	All Load Cases	N/A

Model Outputs & KPI's
RNA Acceleration
Mooring Line UF
Platform excursion
Tower tilt
Line Strain
Catenary touchdown
Anchor loading (H & V loads)
Mean and dynamic loads

BASELINE MOORING SYSTEM

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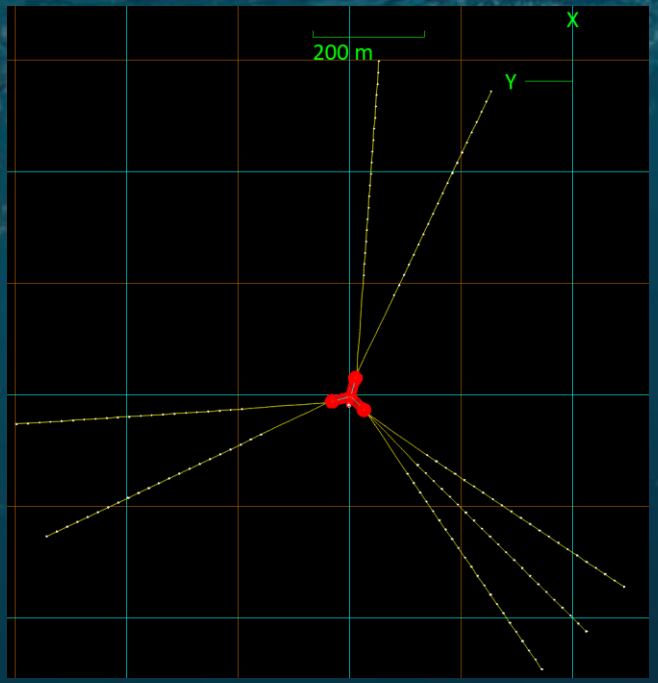
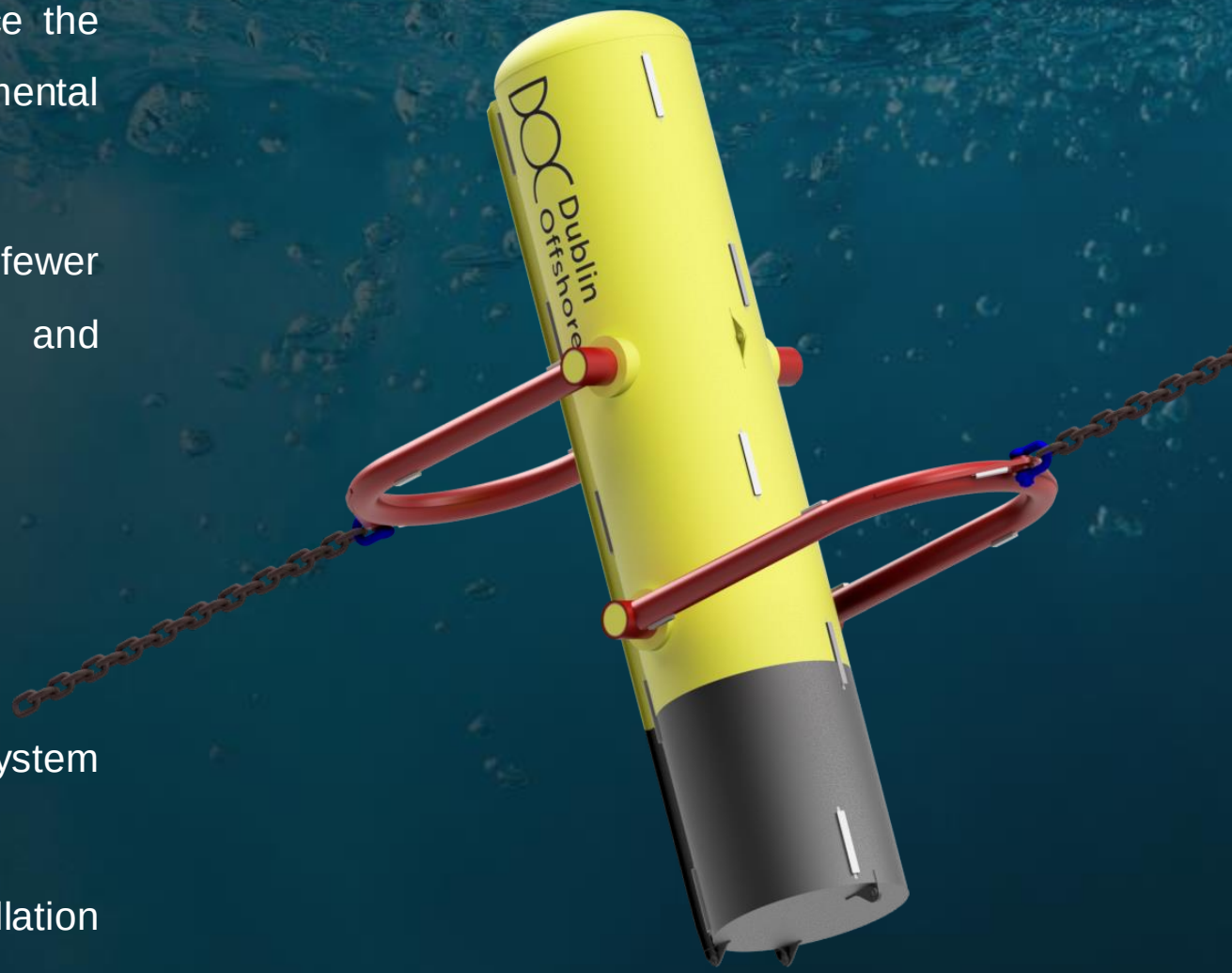
- The Baseline mooring system for the floating wind project was a 7-line mooring system in a 3 - 2 - 2 configuration.
- Mooring equipment sizing is governed by the peak tensions that occur infrequently during extreme storm events.
- This Baseline design included a large volume of heavy chain which while robust is too costly and difficult to supply.
- The CAPEX for this system was estimated to be significant due to the materials (2,200T chain per platform) and installation complexity.
- **Estimated Baseline CAPEX:**
  - **Mooring System Total Cost:** € 470 million

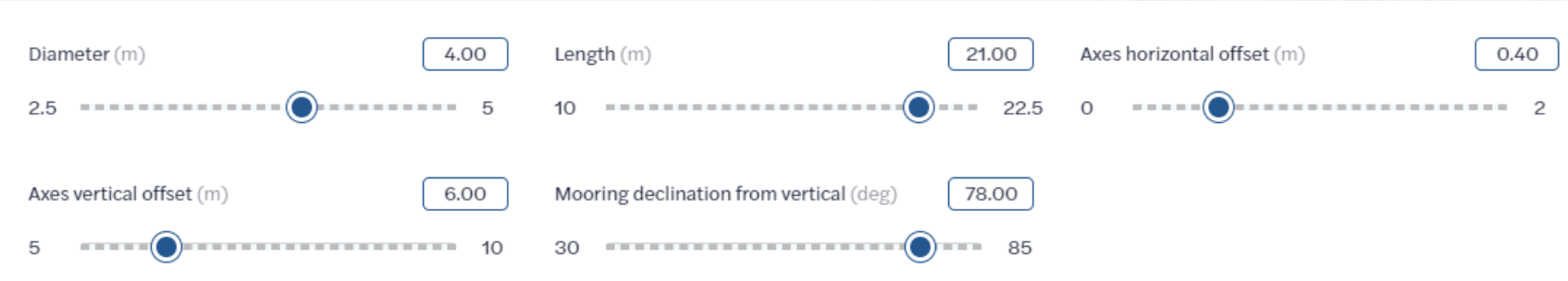


LRD IMPLEMENTATION

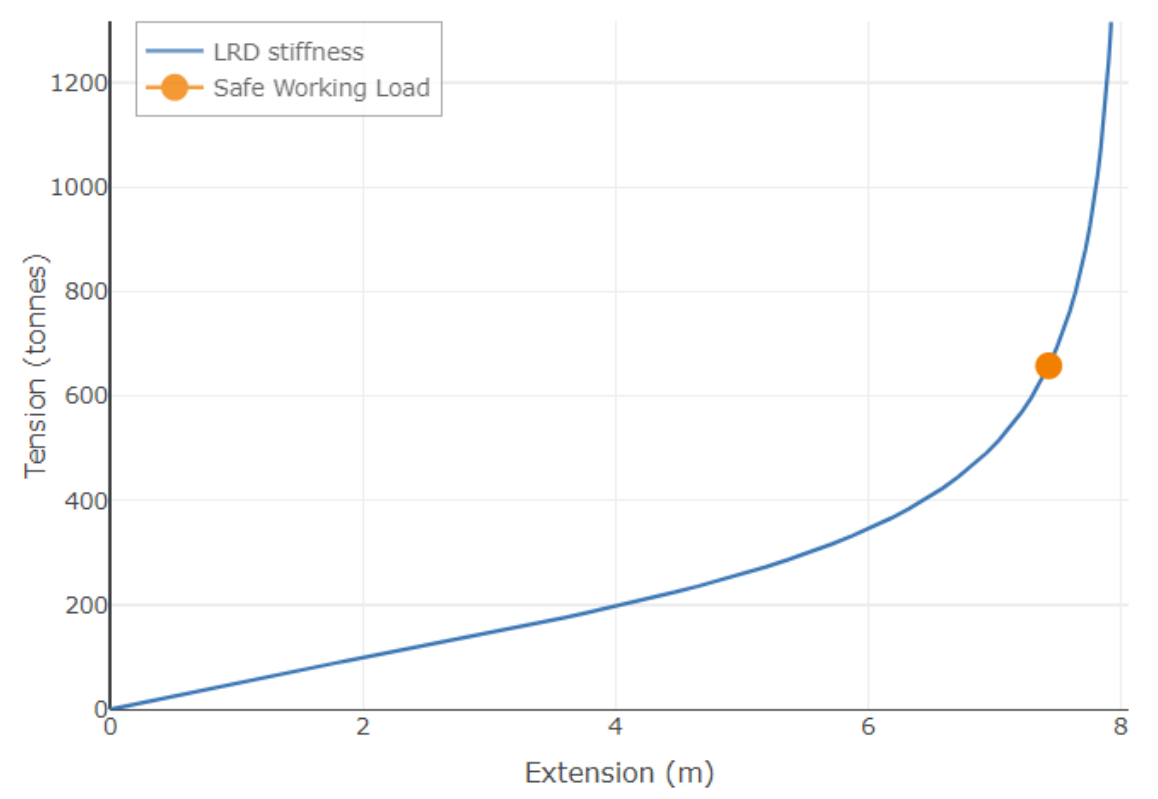
- The Load Reduction Device (LRD) is integrated to reduce the dynamic loads on the mooring lines caused by environmental conditions.
- By reducing these loads, the LRD allows for the use of fewer lines, lighter and less expensive mooring components, and smaller anchors.
- The LRD integrated mooring design project enabled:
  - Removal of 3 mooring lines.
  - Reduction in the diameter and weight of mooring lines.
  - Reduced sizing and quantity of mooring system components due to reduced load requirements.
  - Simplified installation process reducing overall installation time and cost.

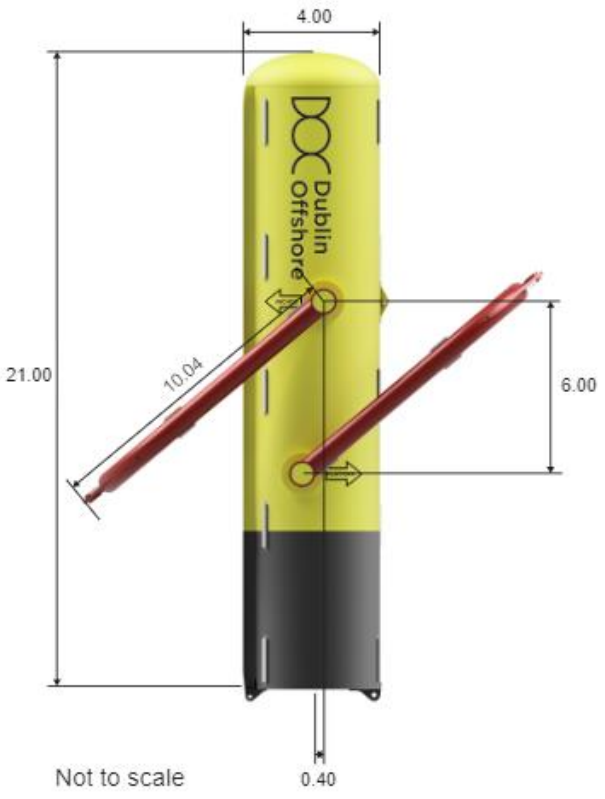


LRD MODEL SIZING OUTPUTS



- Desired response curve generated using MODELS web application on www.dublinoffshore.ie

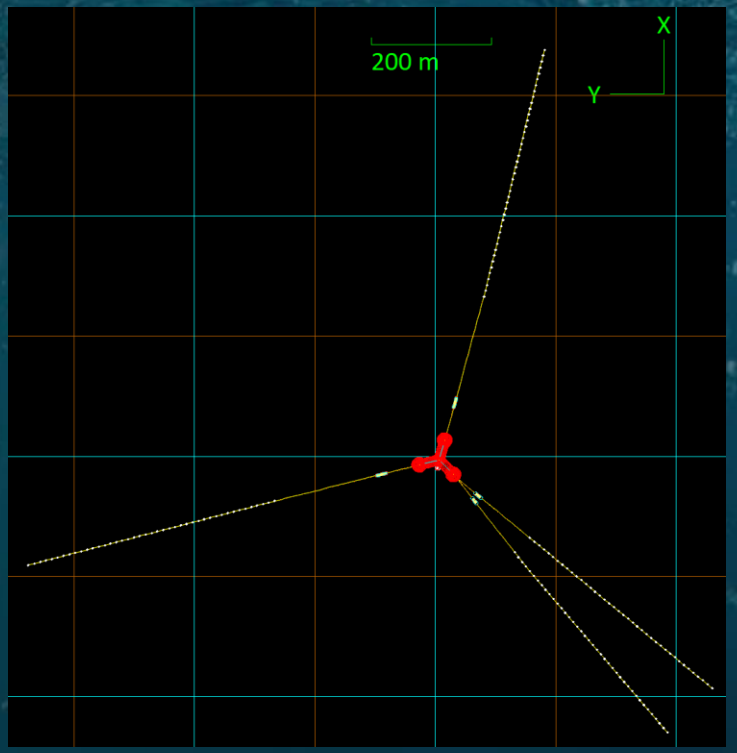




- LRD force – extension response integrated into full system hydrodynamic model
- Optimised mooring specification.
- Auto generation of parametric LRD general arrangement based on basic designer inputs.

OPTIMISED MOORING SYSTEM

- **Reduced Peak Tension allows for the reduction in the number of mooring lines and anchors from a 3 - 2 - 2 system to a 2 - 1 - 1 system.**
- **Revised Mooring System Design:**
  - **Mooring Lines:** In this example the same chain specification is used and the load reduction is used to reduce line quantity (system mass reduced from 2227T to 1097T excluding LRD)
  - **Redundancy :** Maintained in direction of dominant wave
  - **Anchors:** Quantity of anchors reduced from 7No to 4No of the same type and specification.
  - **Installation:** Simplified and faster due to reduced weight and complexity.
- **Revised CAPEX with LRD:**
  - **Optimised Mooring System Total Cost:** €325 million
  - With the introduction of the LRD, the project saw a substantial €145 million saving excluding the reduced anchor costs.



CONCLUSION

- The integration of the Load Reduction Device (LRD) into the mooring system of a 1GW floating wind project resulted in a €145 million reduction in mooring CAPEX. A further >€50 million cost saving is expected from the reduced anchor quantity.
- This innovative approach not only lowered the overall project costs but also demonstrated the potential for significant supply chain and installation opportunities in large-scale floating wind projects.

FURTHER INFORMATION

- **Further Information -** This case study is a high-level summary of extensive design effort over an extended period. Should you require more detailed or further information please get in touch directly by contacting hello@dublinoffshore.ie with the message title ‘CASE STUDY’.

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