

Objective and Scope

Design a mooring system for Hywind Demo that reduces the overall cost of the system.

Scope of work to develop the design:

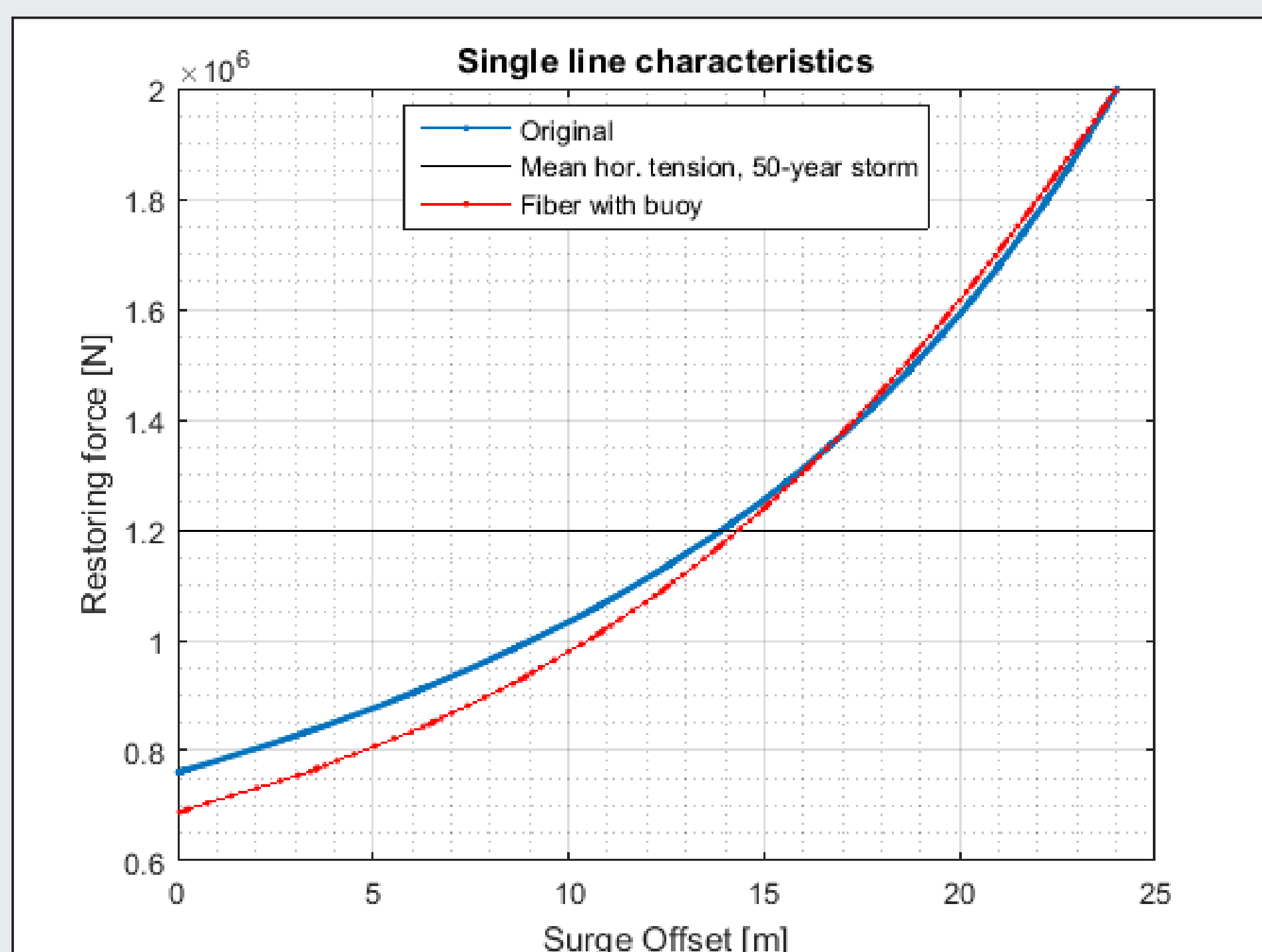
- Define environmental conditions
- Develop frequency domain model of Hywind Demo
- Develop time domain model of Hywind Demo
- Compare the response analysis of original mooring system in the two models
- Design alternative mooring system based on fibre rope

Strategy

Combine elastic stiffness with geometric flexibility in order to maintain the same horizontal stiffness as the original system.

Sea surface and seafloor contact as well as compression in the lines must be avoided.

The line characteristics for the proposed fibre rope system and the original system is compared below.



From the curvature of the line characteristic, it is seen that the buoy introduces a great amount of flexibility.

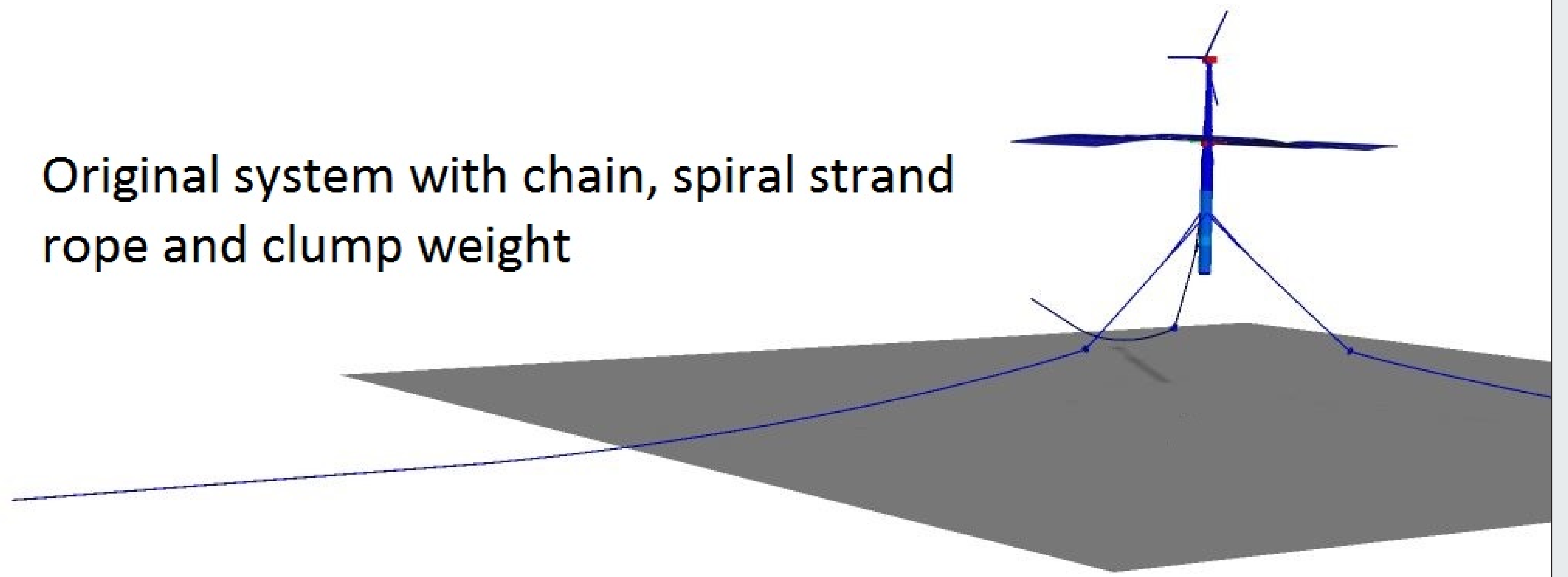
Acknowledgements

This thesis was provided by Rune Yttervik at Statoil ASA, which has functioned as co-supervisor.

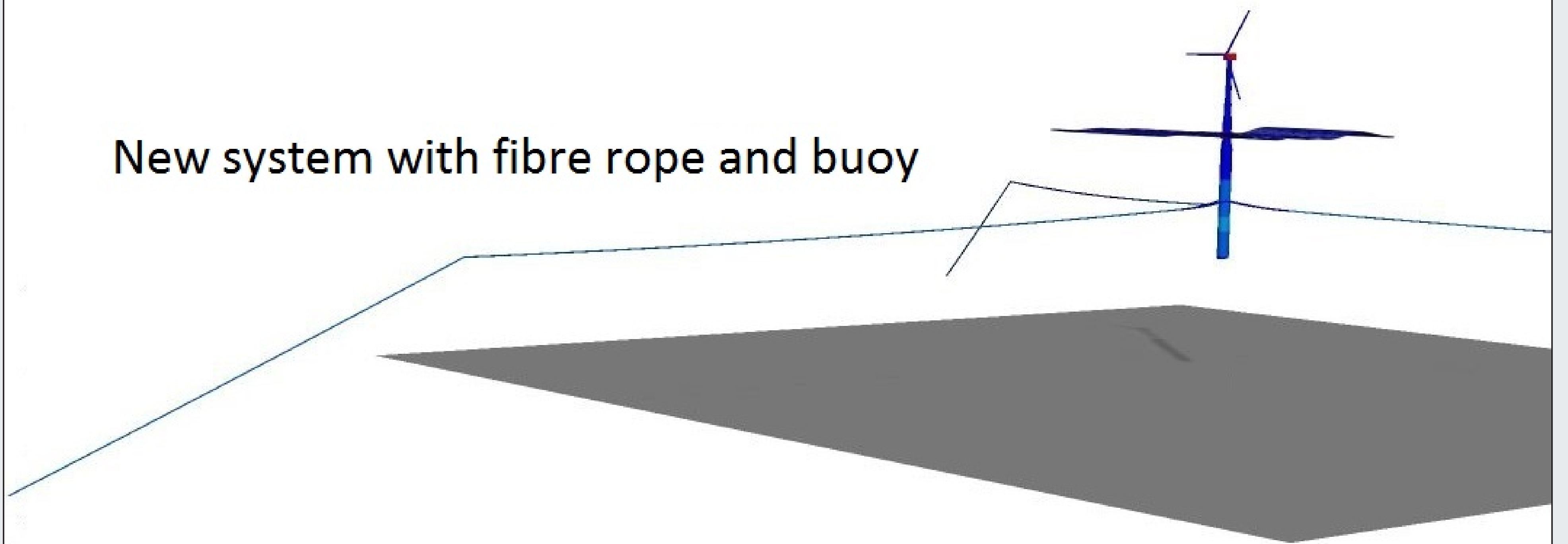
Supervisor at NTNU was Kjell Larsen

RIFLEX models

Original system with chain, spiral strand rope and clump weight



New system with fibre rope and buoy



Results and Conclusion

By combining elastic stiffness with geometric flexibility, an improved mooring system for Hywind Demo based on fibre rope has been developed.

Key features of the fibre rope system:

- 70% cost reduction compared to original system
- Similar restoring properties as original system
- Similar footprint as original system
- Similar mooring utilization factor as original system
- Compliant with DNV rules and regulations for mooring of floating wind turbines
- Reduced necessary payload capability of installation vessels.
- No risk of ship contact with fibre rope or buoy (line and buoy at >50m depth)

Comparison of material and cost (single line):

Original system

- 380m chain
- 540m steel spiral strand rope
- 45t clump weight
- **Price: \$760 000**

Fibre rope system

- 1000m synthetic polyester fibre rope
- 30t net buoyancy buoy
- **Price: \$230 000**