

Announcement of the NorMoor Joint Industry Project Phase 4

NorMoor JIP Phase 4

Motivation

The age of the fleet of the world's production units is growing, and fatigue is the governing limit state for life extension. Furthermore, as part of the energy transitions the focus on floating wind is escalating. Commercial scale wind parks are being planned with several hundred individual mooring lines, and safe and efficient mooring of floating wind turbines are essential to keep production availability at desired levels. For floating wind fatigue of the mooring lines is governing for the design, and therefore also for life extension for these systems.

While Phase 3 of the NorMoor JIP was an important step to improve the design requirements for FLS, life extension will further require a reassessment of the mooring chains in order to predict future degradation.

When a unit is reaching its design life it is necessary to perform a condition assessment of the mooring chains and reassess the fatigue capacity to see if life extension can be achieved with the existing mooring system. However, a methodology for reassessment of chain accompanied by criteria for chain replacement is lacking in today's rules and regulations and is suggested as further work in this Phase 4 of the NorMoor JIP.

Objective

The main objective of the recommended further work in a phase 4 of the NorMoor JIP is to:

- Develop a methodology for reassessment and life extension of mooring systems based on fatigue capacity from a limited number of unit specific fatigue test results and inspection in combination with mooring fatigue analysis.
- Establish criteria for when chain replacement is required for a specific line and sub-segment of line.

Why join?

The results and deliveries from Phase 1, 2 and 3 of the JIP have shown that more cost-effective mooring systems can be obtained, without jeopardizing the safety level. Now in Phase 4 by developing methodology for reassessment of mooring systems based on state-of-the-art degradation models for chain in combination with mooring fatigue analyses we will:

- Reduce conservatism when estimating fatigue damage and life extension. This implies prolonged life for an existing mooring system compared to a more conservative approach. As an example, for a 16-line system the savings per facility¹ for life extension are:
 - Life extension 2 years: 27 MNOK saved
 - Life extension 5 years: 72 MNOK saved
- Meet important needs within offshore floating wind development. For wind farms fatigue of mooring chain is a significant value driver, and degradation models and methodology for reassessment are therefore of particular importance.

By joining this JIP the participants will

- get the possibility to influence on the work and decisions made.
- The JIP is an excellent meeting place to exchange experience and knowledge
 - Other companies may face the same challenges as you do!
- You will contribute in updating tomorrow's rules for life extension

Scope

The high-level scope is to develop a methodology for how to best carry out and utilise fatigue test data and chain inspection in combination with mooring analyses for a specific installation for reassessment and life extension.

The plan is to establish a two-step procedure for the reassessment of the chains. A) based on visual inspection and measurements for the actual chain and generic fatigue strength data for used chain, and B) based on fatigue testing of the actual chain.

Some important tasks include

1. Degradation modelling.
Key input for estimating the degradation in the future will be the condition and corresponding fatigue test of the used chain. Different degradation modelling approaches will be explored and evaluated towards the test data to the extent possible.
2. Reassessment methodology
Since the degradation of chain is case and location dependent, specific fatigue testing of the used chain in the actual mooring system will always give the most reliable result.
It is not always possible or desirable to collect test samples for the actual case. It would therefore be beneficial in such cases, and as an initial assessment while waiting for the test to be carried out, if we could establish a conservative approach based on inspection of the actual chain and generic fatigue strength data for used chain. This approach could then be supported by

¹ Typical North sea system at moderate water depth, and suitable for changing the mooring lines (winches on-board the facility). Cost of engineering, wire rope and shut down not included. Based on 1000 m chain per line, 10 MNOK each, and new anchors, 2.5 MNOK each. Anchors installed first, day rate 2MNOK. Chain installation, day rate 1 MNOK. Assumed installation time is 1 day per line and anchor and 3 days mob/demob for each. I.e. total installation time for a 16 line system is 38 days. Based on net present value at interest rate 5%.

fatigue tests for the actual case if the desired life extension is not achieved or if improved results are required, including determination of year when replacement might be needed.

3. Results from mooring analyses will be used as input to the reassessment procedure. One reassessment procedure for fatigue of mooring chain and one for overload will be developed.
4. Structural reliability analysis will be carried out and the methodology will be calibrated to ensure that the selected target is met.

Deliverables

Each work package will be documented in separate report(s), and the final delivery will be an extensive summary report giving an overview of the work performed including the JIP recommendations.

The results from the JIP will be used in forthcoming updates of DNV's standards DNV-OS-E301 in particular. These updates are covered by DNV and not included in the scope funded by the participants.

Participation and fees

The fee for participation is:

- Operators: 850 kNOK payable over 2 financial years (2023 and 2024)
- Others: 350 kNOK payable over 2 financial years (2023 and 2024)
- Regulators free of charge as observers (without vote in steering committee)
- Manufacturers: contribution with test-data (without vote in steering committee)

Flexibility with respect to invoice schedule will be offered and agreed with participants as needed.

Time schedule

NorMoor JIP Phase 4 will be carried out over a period of about 2 years, with the following preliminary schedule:

- March 15th 2023 - Kick-off at DNV Høvik
- 2023-2024 - Workshops & steering committee meetings 2 per year
- December 2024 - Close out meeting
- March 1st 2025 - Project termination date

The SC meetings will be physical meetings, time and place will be decided at the kick-off and subsequently at each meeting. It is suggested to have 1-2 meeting during the FPSO week. All meetings will be arranged as hybrid meetings such that those not able to attend in person can follow the meeting via Teams.

For more information, please contact

If you have questions to the JIP plans please do reach out to us.

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