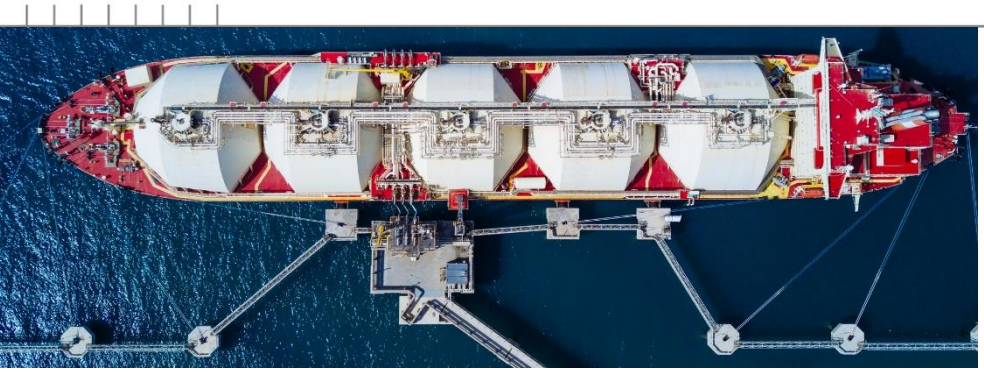
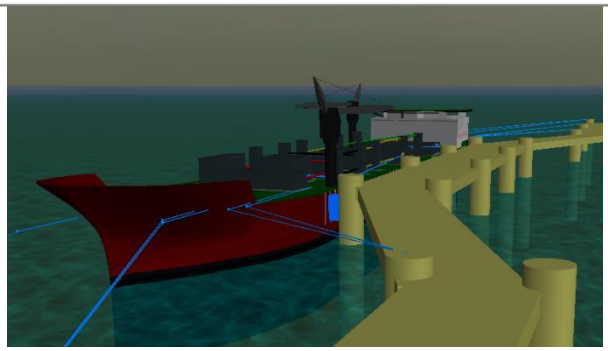




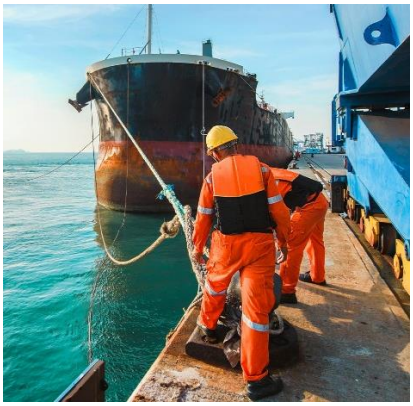
JIP - EQUIVALENCY OF INNOVATIVE MOORING SOLUTIONS

Assessment of the Performance of Conventional Mooring Systems in Terms of Probability of Failure, Safety Performance and Operability, including all Components of Mooring Design and Operations

One of the reason why the innovative technologies are not largely applied in the Oil & Gas business is due to the fact that operators and new technology providers have indicated that it is not easy to demonstrate that their system is equivalent to the conventional mooring systems. In this JIP, the performance of conventional mooring systems will be demonstrated, and expressed in terms of probability of failure, safety performance, and operability.

What's new?

- Failure Mode and Effects Analysis (FMEA) for conventional mooring systems in a HAZID Workshop
- Methodology to demonstrate performance of mooring systems in terms of probability of failure, also including Human Factors
- Survey and classification of observed mooring system failures in terminals and harbours
- Compare statistics of mooring system failure between observations from the field and calculated data

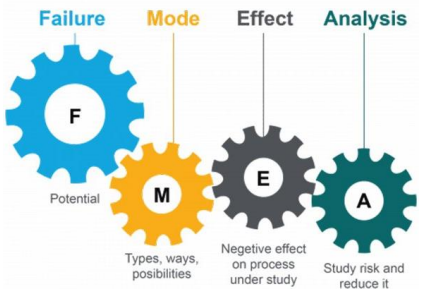


Background

Traditionally, oil tankers and gas carriers are moored to jetties using conventional moorings, with mooring lines to quick release hooks or bollards. Over recent years there are new mooring technologies (magnetic, vacuum, control systems…) developed to reduce the mooring and unmooring times, to improve operability and increase safety. This technology is often installed on quay walls and container terminals, but it has not found many applications in the Oil & Gas business so far.

The Mooring Equipment Guidelines (MEG4) provides guidance on the application of new technology and the required studies and assessments that are recommended to be performed for the safe operations. One of the recommendations included is to demonstrate "equivalency". One of the reason why the innovative technologies are not largely applied in the Oil & Gas business may be due to the fact that operators and new technology providers have indicated that it is not easy to demonstrate that their system is equivalent to the conventional mooring systems. This JIP will lead to guidelines that will help operators and suppliers in demonstrating equivalency.

The MEG4 states that equivalency should be demonstrated through detailed data analysis of engineering or design studies and prototype and/or on-site field testing and experience. The data analysis should be compared against the established technology that it is proposed to replace, complement or supplement. The data provided for the analysis of equivalency should be capable of demonstrating that the technology will at least meet or exceed the performance of traditional mooring including the probability of failure of the mooring system.



Envisaged participants:

- Port & Mooring Engineers
- Mooring Line Suppliers
- Equipment suppliers
- Terminal Operators
- Vessel Operators
- Port Authorities
- Class Societies

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The challenge that new technology providers seem to have is to provide this actual demonstration, showing that the probability of failure of their system is low, and meets or exceeds performance of traditional moorings. Traditional mooring practice, analysis and safety factors have been developed over time based on experiences. There is a lot of focus on proper mooring configurations and mooring line handling, operational procedures, inspection and maintenance as well as keeping high safety factors between the capacity of the lines and the actual mooring forces. However, the actual probability of failure is not known, or at least not documented.

Objectives

The objective of this proposal is to demonstrate the performance of conventional mooring systems. Such performance needs to be expressed in terms of probability of failure, safety performance and operability.

The project will clearly define the components of the facility design and facility operations that are impacting the safety and performance of the mooring arrangement (mooring arrangement, mooring line design, mooring line condition, operational tending of the lines…etc.). This is important to consider given that innovative mooring solutions do not only have a different design and reliability, but are probably also less impacted by other aspects such as human factors.

Work Packages

The scope of work will be divided in the following work packages:

- WP1 – Definition of the Method Statement, HAZID Workshop, and Failure Modes and Effects Analysis (FMEA)
- WP2 – Assessment of the probability distribution of line capacity, of mooring line tension and of mooring line failure
- WP3 – Comparison of statistical data “Observed on the Field vs. Calculated” and Analysis of Consequences for Operability and Safety

Deliverables

The main deliverable will be a summary report and information paper, that can be used as a complement to the MEG4 guidelines. The deliverables will also include the report of the HAZID Workshop including list of failure mechanisms and FMEA results, and the results of the survey about observed mooring line failures.

Organization and Schedule

This work will be conducted as a Joint Industry Project to ensure that we have sufficient experience, capabilities and facilities available. Results and costs will be shared. The foreseen partners to execute the work are MARIN and DNVGL, but additional partners (e.g. mooring line manufacturers) may be involved as well. The project participation is open for all stake holders. The JIP will run for 2.5 years. The kick-off meeting where scope and task assignment will be finalised is scheduled in Q4-2021.

Participation Fees

A target participation fees of 50k€ (~17k€/year) is foreseen for the operators and energy companies, and 20k€ (~7k€/year) for the other participants.

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