Structural Health Monitoring Systems (SHMS) optimise risk management efforts and secure long-term investments

With mature fields representing an ever-growing segment of global offshore reserves, there is a keen interest in maximising recovery from existing oil fields to keep up with global energy demand.

Throughout more than four decades of experience in engineering solutions for the oil and gas industry, Ramboll has developed innovative, cost-effective approaches to field lifetime extension.

Combining a variety of sensing technologies with an embedded measurement controller to log and analyze real-time data, our engineers use advanced calculations to determine the actual structural integrity of a platform. High-tech measurements can minimise the cost of maximising recovery from existing oil and gas fields.

Operators are able to prolong field life while keeping track of the undergoing changing conditions of the structure. Quantifying uncertainties improve safety and reduces the frequency of inspections which, in turn, will minimise the operational cost of maintaining the platform on stream.

Selected projects

South Arne Platform - Wave load calibration
Client: Hess, 2009 - 2011
The aim of the project was to extend the lifetime of the platform through wave load calibration and re-assessment analysis based on post-processed data from SHMS measurements and wave basin laboratory tests.

Thanks to an impressive combo of disciplines summed up to structural engineering, wave expertise, FEM software development and technical specifications, the project reached its goals by benefiting from the complete set of services - from detailed design to valuable input for the risk-based inspection planning - a feature that the lifecycle of SHMSs entails per assemble.

The aftermath of the wave load calibration and re-assessment analysis resulted in increased fatigue life, a positive outcome that, in the end, allowed the platform to continue its production without performing structural changes to the platform.

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THE BENEFITS OF USING SHMS

The greatest asset of SHMS is to provide real time information about all relevant structural changes which occur in the structure. This in turn renders:

- Prolonged remaining field life
- Reduced frequency of inspections
- Improved safety by quantification of uncertainties
- Reduced operational cost (OPEX)

Siri Platform - FEM updating/re-assessment

Client: DONG Energy, 2010 - 2015

The purpose of the project was to validate the structural models of the platform based on state-of-the-art SHMS analysis before and after reinforcements - initiated due to observed structural changes.

The services provided ranged from detailed design of the SHMS to condition based structural re-assessment and authority certification. The optimal positions of the sensors were pre-tested and evaluated by performing analyses using simulated data from a finite element model (FEM). The measurements were post-processed and the modal parameters were determined using Stochastic Subspace Identification (SSI) methods. FEM updating and wave load calibration were performed using advanced signal post-processing, optimisation and structural analysis techniques.

Bayesian based FEM updating of the As-is conditions (SHMS) revealed increase in fatigue life compared to standard based analysis.

Valdemar Platform - Wave load calibration

Client: Maersk Oil Denmark, 2011 - 2015

The scope of the project comprised system identification (OMA), FEM updating, wave load calibration and model uncertainty verification in terms of coefficient variation (CoV) that could form the basis for reduction of the number of inspections (RBI).

Following an extensive set of services for condition based structural reassessment and IP - a unique package for the oil & gas industry - the results turned out to be very confident, strengthening the philosophy of secured and optimized long term investments that SHMS tries to convey.

Besides FEM updates towards modal parameters, and combination of a new wave theory - both confirming an increased fatigue life - the most important outcome of the analysis was the verification of model uncertainties. A low value of CoV reinforced the hypothesis of reduced number of inspections, indicating a significant minimization of the financial cost for structural maintenance.

Moreover, results from the analysis for one platform formed the basis for decision making for other 12 existing similar types of platforms and future field development.