Summary report – RCN project no. 188913/I40

Construction and intervention vessel for Arctic conditions

Project period: September 2008 – December 2011

Project partners:

MARINTEK

CeSOS, Norwegian University of Science and Technology

Statoil

STX OSV

VTT

Aker Arctic Technology

Introduction

Interest in oil and gas exploration and production offshore northern Norway is growing. The subsea gas production system at Snøhvit has been in operation since 2007, while oil production from a Sevan type FPSO on the Goliat field will start in 2013. The Skrugard exploration drilling results from 2011 (and Havis from January 2012) shows the potential of the Norwegian part of the Barents Sea as a new oil and gas province. Combining this with the 2010 maritime border delimitation agreement between Norway and Russia, both nations have increased their seismic survey activities in the previously disputed section of the Barents Sea

Project objectives

The primary objective of the project has been to extend the operational season for installations and maintenance of subsea oil and gas installations in waters with seasonal ice. To obtain the primary objective the following secondary objectives must be realized:

- Development of maintenance philosophy where unplanned intervention takes place in periods with seasonal ice
- Definition of operational limits/weather windows for intervention tasks
- Vessel design to optimize operational characteristics in harsh weather
- Design trade-offs to find a vessel with high performance in harsh weather and first year ice

Project outcomes

The project has reviewed the present maintenance philosophies used by oil companies. Referring to recent accidents with oil and gas installations it is needed to improve IMR methods for Arctic oil and gas production to make it possible to perform unplanned IMR during the winter season in waters with seasonal ice.

Work distribution

The layout of the project work packages is shown in Figure 1. MARINTEK has supported work package leaders for all work packages except WP 5 "Environmental footprint" where the work package leader came from VTT.

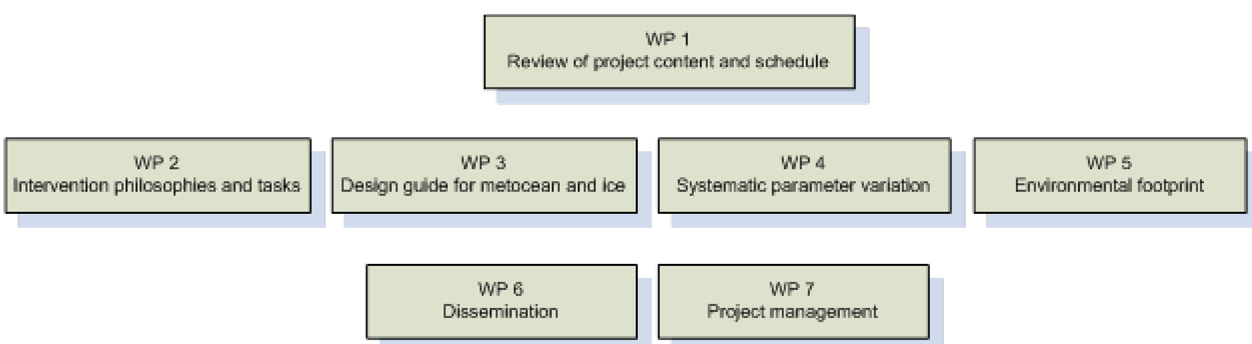

Figure 1 Work package definition

Work progress and resources

Due to change of work package leader for WP 3 "Design guide for metocean and ice" this work package has been delayed. Initial collection of information was according to the schedule, but the final internal deliverables from this WP were delayed until the end of the project period.

Model tests at MARINTEK and Aker Arctic Technology were completed as planned. The following model tests have been conducted during the project period:

Date	Design	Test scope
2009-12	# 1	Calm water performance and seakeeping tests in the MARINTEK Towing Tank
2010-11	# 2 (final)	Seakeeping- and stationkeeping tests in the MARINTEK Ocean Basin
2011-01	# 2 (final)	Calm water performance and seakeeping tests in the MARINTEK Towing Tank
2011-05	# 2 (final)	Model tests in ice in the Aker Arctic Ice model tank: Ice performance, maneuvering and DP force.

In addition MARINTEK and Aker Arctic have done some numerical studies. MARINTEK performed CFD-calculations to be able to estimate the contribution of the headboxes and pods to the total resistance. By doing so one could estimate the potential for resistance reduction by reducing the resistance on the mentioned units. In order to support the vessel conceptual and hull design numerical predictions for the ice operability were carried out by Aker Arctic prior the ice model testing. These included ice resistance estimates both ahead and astern, time domain simulation on the turning capability in level ice and also predictions for the ice loads affecting on the ship hull during a DP-operation.

VTT lead the work to study the environmental footprint for the intervention vessel. The main part of their study has been related to normal operational emissions. The main attributes in the calculation have been fuel consumption and emission factors. The fuel consumption derive from required power for different operation modes and is dependable on the engine loads, optimum being somewhere near 80–85%. Some of the emission factors (CH_4 in particular) are notably higher on low engine loads. The results are case-specific and should not be generalized to other diesel and dual fuel option comparison. The study supports the need for life cycle assessment (LCA) when evaluating the environmental impact of fuel selection. When evaluating the fuel options the focus should be in the whole GHG entity instead of single parameter. Calculating the global warming potential enables the comparison between CO_2 and CH_4 emissions. Equally, the NO_x and SO_x emissions comparison is possible by calculating the acidification potential.

The second part of VTT's work was made in response to a request from one of the industrial project partners (Statoil). Statoil asked for a review of ongoing research on oil spill in ice. No additional resources were made available for this task so it was agreed to limit the work to give an overview of recent research in Finland and Norway. The aim of the written report was to present characteristics of oil combating under arctic conditions. It explained how the ice, cold climate and darkness make the task – which is not simple in open waters – even more challenging. In addition to various recovery methods, oil spill monitoring and detection and oil behavior issues are briefly described.

The Post Doc work was specified to focus on the topics of ice forces on manoeuvring ships. Biao Su, a PhD student at NTNU' CESOS was hired from beginning of May 2011 for a period of one year. He will continue the model development he stared in his PhD thesis and apply it to the case vessel developed in the project.

Use of project results

The outcomes of the project have resulted in a draft design of a new type of intervention vessel for oil and gas operations in the Arctic. The design (OSCV 10 – NOD 440) is shown in Figure 2. The vessel is designed environmental friendly with focus on low fuel consumption and precautions accordance with DNV's CLEAN DESIGN requirements are incorporated in the design.

Figure 2 Visualization of vessel design OSVC 10 – NOD 440 (courtesy by STXOSV)

The vessel is specially designed and equipped for Subsea operation duties with a high focus on good sea-keeping abilities and excellent station keeping performances. The vessel is designed with STXOSV's new optimized hull form and bow shape, and ice breaking capabilities at stern.

Results from the project have been presented at international conferences and seminars. For 2012 project outcomes will be presented at:

- 8th Annual Arctic Shipping, Helsinki 24-26 April
- 4th Annual Offshore Support Vessels, Singapore 23-26 April
- 31st International Conference on Ocean, Offshore and Arctic Engineering, OMAE 2012, Rio de Janeiro, 10-15 June
- Offshore (Ocean) and Polar Engineering Conference – ISOPE 2012, Rhodes, 17- 22 June

Additional project outcomes

The project has made a collaboration agreement with the KMB project "Arctic DP" led by Professor Roger Skjetne at NTNU. Further there have been initiated collaboration activities with one of the work packages in the new Center for Innovation Based Research SAMCoT on measurement of metocean and ice parameters in the Olga Basin.

MARINTEK has increased collaboration with Norwegian Meteorological Institute through the project and will continue collaboration as part of Maritime21 activities.

MARINTEK has also increased collaboration activities with the Finnish research institute VTT. The maritime part of the Memorandum of Understanding between SINTEF and VTT has been revised and signed for a new period. The project has initiated relations between MARINTEK and Aker Arctic Technology and resulted in joint use of model equipment (propellers and thrusters).

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