Session – Risk

Title: **Risk Analysis of DP Operations for CAT-D Drilling Unit in the Troll Field**

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Abstract

The CAT-D drilling units are dynamically positioned semisubmersible drilling rigs designed for operations on the Norwegian Continental Shelf. The rig is designed to meet DYNPOS-AUTRO and DYNPOS-ER notations. There are three DP redundancy groups designed on the rig, and single failures including fire or flooding in one compartment will in maximum result in loss of one DP redundancy group, i.e. two diesel generators, or two connected 11kV switchboard sections, and/or two thrusters. Within each DP redundancy group the rig is designed with extra fault tolerance capability against single failures. Except for fire/flooding events and failures related to 11kV bus coupler, single failures can only result in loss of one DG, or one 11 kV switchboard section, and/or one thruster. This represents a significant step forward to reduce the vulnerability of DP class 3 system towards single failures.

The enhanced reliability in the overall DP system and in particular, the most likely expected single failure effect, i.e. loss of one thruster in station keeping, is the background for this risk analysis. After significant extra investment on the design and construction of the rig, should rig operator still plan the DP operation in a similar way as other contemporary DP class 3 rigs, i.e. based on single failure effect of losing two thrusters? Or can this rig be operated with single failure effect of losing one thruster? If so, what if a fire happens and consequently results in loss of two thrusters? It may result in a drift-off situation. What is the risk of losing the well integrity? Moreover, how frequent had a fire event happened on DP drilling rigs? And how frequent may such event occur on the CAT-D rig that can result in drift-off in the Troll field? A risk analysis is performed to provide answers to above questions. It should be noted that failures related to 11kV bus coupler are also analyzed in the risk analysis project, but contents in this paper are focused on fire and flooding.

The objective of the risk analysis is to evaluate the risk of loss of well integrity in the Troll field due to DP position loss. The focus is to analyze and compare risks given two different DP operational bases for the CAT-D rig, i.e. WSF2 (which means DP operations are based on the worst case single failure of losing two thrusters), vs. WSF1 (which means DP operations are based on the worst case single failure of losing one thruster). The historical fire and flooding frequency is derived in this study for mobile offshore drilling units. Fire/flooding as well as 11kV bus coupler failures can cause loss of two thrusters, and rig will slowly drift off given DP operation based on WSF1. Such scenarios are simulated by time domain simulations using rig specific model and environmental conditions in the Troll field. Event tree analyses of rig position loss and barriers, i.e. automatic EDS, human operator, and independent ADS system, are performed. The results demonstrate that DP operations based on WSF1 have equivalent safety level of well integrity as DP operation based on WSF2 in the Troll field. Recommendations to relevant DP operational procedures, DP software consequence analysis function and relevant operator trainings are further proposed.