

From paper WSOG (Well Specific Operating Guidelines) to a digital eWSOG.

Mike Lindsley – Seadrill, +44 7748182796, mike.lindsley@seadrill.com

Max Russo – Kongsberg Maritime, +1 8329299911, max.russo@kongsberg.com

**Rune Haakonsen – Kongsberg Maritime, +1 832-266-8416,
rune.haakonsen@kongsberg.com**

The Well Specific Operating Guideline (WSOG) is a “one-pager” document used to define operational limits and actions to be taken by the rig crew (specifically, DPO and driller) when these are exceeded.

WSOGs are developed to reduce the risk of accidents during drilling operations. They are specific for each well-drilling rig combination and they are established during the planning phase of the operations. Although the WSOG form can be amended or expanded to capture additional conditions, traditionally it contains four status types (colours), associated with specific actions to be taken accordingly. Green, blue (advisory), yellow and red are the typical colours used to define these statuses. Typically, the WSOG includes static limits for several operational variables, as for example the vessel dynamic foot print (position offset from wellhead), thruster capacity utilization, generator capacity utilization, riser angle, flex joint angles, vessel motions, and the environmental conditions.

Important key aspects as well integrity and riser integrity are typically not explicitly included in the WSOG but they are indirectly considered when setting other limits as the vessel offset, heave and heave velocity or wave height and wave period. Since the WSOG is a static paper-based document, interaction and dependencies of the various aspects are typically not considered.

Traditional paper-based WSOGs are developed considering a fixed collinear environmental condition, typically one-year return period or 95% non-exceedance. Consequently, this approach may lead to conservative limits for most of the time when the environment is more benign. Especially shallow water dynamic positioning (DP) drilling operations can experience high non-productive time when using a traditional WSOG with limiting watch circles and environmental criteria. At the same time, traditional WSOGs have sentences in their common form as “if threaten to position” which may leave the DP operator on board with a heavy burden of taking critical decisions based on insufficient information.

On a typical new generation drilling rig all the major systems as the automation system, the dynamic positioning system and the riser management system, are normally interfaced to an information management system virtually allowing real-time control of most operational aspects at any time, both offshore and onshore. Leveraging this unique interconnectivity and driven by the efforts to digitalizing and automate the drilling operations, a new electronic version of the WSOG, the eWSOG, was developed.

The purpose of the eWSOG is to replace the existing paper based WSOG with a software application interfacing all the relevant systems and sensors, and including real-time assessment of safety margin to all critical limits. The main goal of the eWSOG is to increase safety and efficiency of drilling operations adopting dynamic limits related to the current environmental conditions and specific for each operation (drilling, completion, etc).

The eWSOG is not only an electronic real-time version of the old WSOG-on-paper, but based on defined algorithms it can consider inter-dependencies between its various elements when defining the status of the operation. When coupled with the enhanced Kongsberg Maritime Riser Management System (KM RMS), it can explicitly take into account well integrity, wellhead fatigue and riser integrity. Specifically, for DP operations in shallow water, the eWSOG with KM RMS allows the crew to adjust the rig position, to maximize the watch circle and thereby increase operability.

In addition to the real-time section, the eWSOG incorporates a predictive part. Based on the weather forecast and a machine learning model trained by using historical data and a detailed fully coupled model (vessel, DP, riser, casing, and soil), the predictive eWSOG forecasts the key parameters of vessel, riser and well response for the next 24-48 hours. This aspect is important since it creates awareness among the personnel, who can now plan and take decisions not only based on predicted weather but based on predicted response-variables (e.g. rig heave, station keeping system utilization, wellhead fatigue damage accumulation).

The eWSOG is available real-time both offshore and onshore allowing the onshore personnel to assist the rig crew in evaluation of challenging situations. All data are logged and stored, facilitating playback of incidents for quicker and precise investigation. The recorded data can also be used to improve the predictive part, tune models and improve the planning of future operations.

The first eWSOG prototype was installed on two Seadrill semi-submersible drilling rigs, operating in shallow water harsh environment for Equinor.

This paper will describe in detail the process of moving from a traditional WSOG to an electronic dynamic version of it for the above rigs. Challenges, solutions and future work necessary will be outlined.