Environment plan
Appendix 2-1
Operability and forecasting

Stromlo-1 exploration drilling program

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Rev 3, November 2019

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1.0 Analysis of operability

This appendix provides further detail on the process of integrating understanding of the metocean conditions at the Stromlo-1 location with the operability constraints of the rigs and vessels under consideration. Our understanding of the metocean conditions at the site is based on careful analysis of measured data and modelled predictions based on long-term historic datasets. A key consideration in selecting suitable rigs and vessels is to assess their ability to operate at any time of year with minimal weather down time, or “waiting on weather” time (WOW).

Operations associated with drilling vary in their sensitivity to metocean conditions and the assessment of operability focusses on the most sensitive operations to set the design criteria for selecting the rigs or vessels. Metocean design criteria are based on extreme conditions, which ensures rare events are manageable and routine operations fall well within the safety limits of the selected equipment. For Stromlo-1, the ability to install a capping stack in wave conditions likely to be encountered at Stromlo-1 has been considered carefully. Time-series wave data for almost 40 years have been used as input in operability analyses. By considering alternatives for operational limits with historic wave conditions we can quantify WOW for various solutions and thereby prepare robust requirements for the capping stack installation vessel and equipment. When interpreting results from operational analyses, our approach conservatively uses P90 results and assumes that the most sensitive parts of operations are occurring throughout the activity. For example, deploying the capping stack needs 38 hours and a constant operations limit will apply throughout the operation. The operation is however, only sensitive to metocean conditions when running the capping stack through the splash zone and when landing the capping stack – two discrete operations of a few hours each. Results from the capping stack operations analysis are shown in Appendix 7-4, Figure 3-1.

Figures 1 and 2 illustrate the differences in available time for operations limited by significant wave height (Hs) of 4 m (Figure 1) and 3 m (Figure 2). The intention is to use a vessel capable of installing the capping stack in sea states with Hs up to 4 m, independent of what the wave period is. The motion characteristics of the capping stack installation vessel will be assessed for operability; taking wave periods, wave directionality, vessel responses and the effect of swells and wind seas from different directions into account. This will quantify how often unfavourable conditions may occur based on simulations from time series of metocean data and therefore how often the vessel (or rig) would have to wait for the weather to improve. Only vessels showing very limited waiting time will be considered for use. This approach has been applied successfully to offshore drilling operations worldwide.

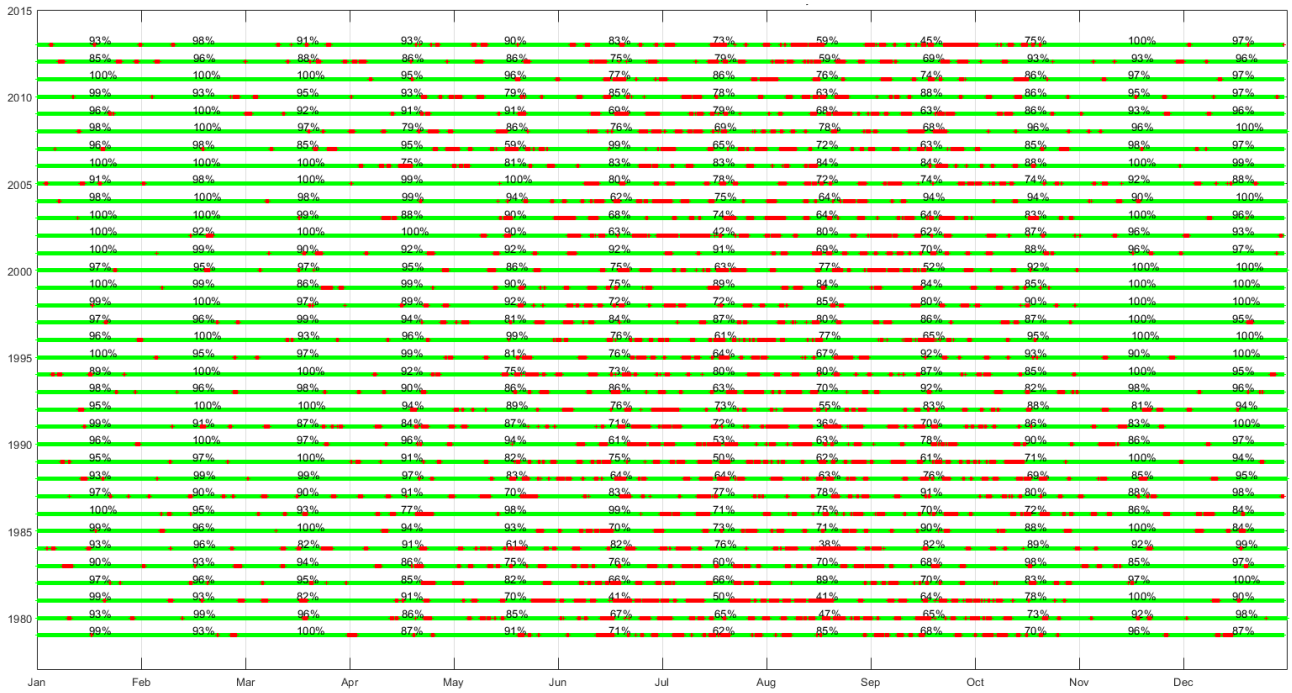

Figure 1 Weather windows for operations limited by Hs of 4 m at the Stromlo-1 location. Green represents favourable conditions while red represents unfavourable conditions

Figure 2 Weather windows for operations limited by Hs of 3 m at the Stromlo-1 location. Green represents favourable conditions while red represent unfavourable conditions

2.0 Forecasting and monitoring during drilling

For all offshore operations, swell and waves may cause unacceptable motions to vessels and rigs. To reduce both safety risks and waiting time, Equinor Australia B.V. actively uses weather and wave forecasts together with wave and motion monitoring. This ensures that operations are stopped safely before any operations limit is exceeded. Wave monitoring at the offshore location is important for validating forecasting services and allowing forecasters to correct and improve their forecasts. In addition to forecasting the weather, forecasted wave spectra will be applied to predict how the vessel/rig motions will be within the upcoming days.

Equinor will engage a professional forecasting agency with knowledge of local conditions to ensure access to good quality wind and wave forecasts continuously during all operations. There will be a weather station on the MODU to assist in metocean situational awareness and to inform aviation plans.

3.0 Rogue waves

Waves with return periods of 50–100 years are considered when making sure that a vessel or rig is capable of working safely within an offshore region. For marine operations with short durations, design limits are usually based on lower return periods. This is reasonable because the entire operation can be completed within a single weather pattern and weather forecasts are monitored prior to, and during, operations. If waves (or winds) higher than acceptable are predicted, the operation will be delayed until a favourable forecast is in place. Rogue waves are considered separately because they cannot be predicted and will not be included in wave forecasts.

A rogue wave (sometimes called a monster wave) can occur in most seas around the world. The phenomenon is generally an event where one wave grows significantly higher than normal by drawing on the energy from surrounding waves. Closer to shore, other mechanisms can cause rogue waves. In general, any “normal” wave within a 3-hour sea state is smaller than twice the significant wave height, whereas a rogue wave is, by the most commonly used definition, greater than twice the significant wave height. A rogue wave is therefore not necessarily a very high wave, it is only high relative to the other waves in the sea state. Rogue waves are of most concern for operations conducted in sea states approaching to the design limit, which assumes no waves higher than twice the significant wave height. The upper limit to how high a rogue wave can be relative to the significant wave height, before it decays, is widely considered to be between two and three times the significant wave height.

Equinor Australia B.V. commissioned RPS Australia West Pty Ltd to study wave statistics from a full year of Great Australian Bight wave recordings with the objective to estimate frequency and severity of rogue waves. Preliminary results show that Great Australian Bight waves are not steep and individual wave heights are within the limits of traditional wave statistics. Comparisons with data from the Equinor Kvitebjørn (Norway) installation shows that rogue waves are less frequent in the Great Australian Bight than in the North Sea. While approximately one out of 70,000 individual waves in the North Sea are higher than two times the significant wave height in the sea state they occur, the corresponding frequency is about half of this in the Great Australian Bight.

In order to avoid damage during marine operations, weather restricted operations always establish and clearly describe all operation-limiting criteria. Operational limits can be introduced due to limitations in equipment (e.g. ROVs and cranes) or as identified in HAZID/HAZOP. Operational limits used in selecting rigs and vessels for the drilling activity in the Great Australian Bight, shall include a margin relative to design limits. This margin shall ensure that in the unlikely event that a rogue wave occurs during the time and at the place of the activity, no harm is caused.