

## DP Consequence Analysis – A Timely Reminder

### 1 BACKGROUND

Following a review of the 2020 Annual DP Station Keeping Event Report published by IMCA in January 2021, the IMCA DP Committee agreed that an objective for 2021 was to create an information note explaining the subject of DP consequence analysis and its benefits in reducing DP Station Keeping events whether they be in the category of DP Incident, DP Undesired Event or DP observation.

The DP Consequence Analysis system can be explained as:

*“A monitoring function in the DP control system that issues an alarm if the vessel, (in its current operation mode) in the current weather conditions, would not be able to keep the heading and/or position in the case that the predefined worst-case failure should occur”.*

From the definition, it can be seen that this is an important operational tool for verifying the safety of DP positioning and it must be active in all class 2 and 3 operations.

### 2 CURRENT IMO REQUIREMENTS

IMO MSC.1/Circ.1580, *Guidelines for Vessels and Units with Dynamic Positioning (DP) Systems*, makes clear the requirement for DP systems to have consequence analysis functionality available to, “...continuously verify that the vessel will remain in position even if the worst-case failure occurs”. The previous version of the IMO guidelines (IMO MSC/Circ. 645) contains very similar wording in relation to consequence analysis.

The guidance goes on to state, *“This analysis should verify that the thrusters, propellers and rudders (if included under DP control) that remain in operation after the worst-case failure, can generate the same resultant thruster force and moment as required before the failure. The consequence analysis should provide an alarm if the occurrence of a worst-case failure were to lead to a loss of position and/or heading due to insufficient thrust for the prevailing environmental conditions (e.g. wind, waves, current, etc.). For operations which will take a long time to safely terminate, the consequence analysis should include a function which simulates the remaining thrust and power after the worst-case failure, based on input of the environmental conditions.”*

Consequence analysis assists the DPO to make the necessary operational decision. In simple terms, whenever the DP consequence analysis triggers an alarm, the vessel is already in a degraded operational condition and may not tolerate a failure and be able to maintain station keeping, and so, appropriate and immediate action should be taken to ensure the safety of the vessel.

### 3 CONSIDERATIONS

The following considerations in relation to the use of the consequence analysis application are worthy of note:

- The consequence analysis alarm is triggered after the application has calculated that the vessel will not be able to maintain position and/or heading after a single worst case failure.
- Some DP control systems may require the consequence analysis functionality to be manually activated, other systems have the function as default and it cannot be de-selected.

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- The consequence analysis application must be configured by the OEM engineer to match the DP system's redundancy concept and worst-case failure, as determined by the vessel's DP system FMEA and respective FMEA Proving Trials. This must take consideration of the defined and accepted modes of operations. This should be validated during the initial DP FMEA Proving Trials and subsequent periodical testing.
- The consequence analysis setup should reflect that the power and propulsion systems remaining in operation after the worst-case failure can generate the same resultant thruster force and moment as required before the failure.
- The consequence analysis should consider the average power and thrust consumption. Brief, dynamic effects should be removed by filtering techniques.
- For operations which will take a long time to safely terminate, the consequence analysis should include a function which simulates the thrust and power remaining after the worst-case failure, based on manual input of weather trend.
- The consequence analysis repeats automatically at pre-set intervals. On some types of DP control systems the operator can monitor that the analysis is in progress.
- Consequence analysis should take into consideration the use of time-based limited spinning reserve such as battery hybrid systems.
- Many DP systems trigger a timer prior to an alarm when the DP controller detects that the station keeping will be compromised as a result of a failure. If the controller detects that the vessel is back within its limits, this timer is then re-set. The calculations run continually after the consequence analysis application has been activated. The interval and duration of the alarm timer can be adjusted by the OEM engineer. DNV recommends 3 times 1 minute, totalling 3 minutes before the alarm is given.
- Consequence analysis applications are typically non-conservative, meaning that when the system alarms, the vessel may already be compromised from a station keeping perspective. Typically, there are no "pre-warnings" issued and the DPO needs to consider the vessel's capabilities and be mindful of risks, which cannot be foreseen by the DP control system consequence analysis such as imminent environmental conditions. In addition, other alarms might already indicate that the vessel is operating at, or beyond, its limits.
- The DPO must recognize the fact that an intermittent consequence analysis alarm is an indication that the vessel is operating outside of its post worst case failure DP capability. However, the use of a well-developed ASOG should reduce the incidence of a Consequence analysis warning.
- Several DP incidents reported to IMCA demonstrated that the DP system produced a multitude of alarms indicating that the DP system was operating near its limit, before the consequence analysis alarm was triggered. In some instances, a loss of position due to a large wave train was experienced before the consequence analysis alarm was triggered. Therefore, the DP Consequence analysis should not be relied upon as the only decision tool for managing station keeping risk. IMCA M 220 Operational Activity Planning provides guidance to manage station keeping limits, which should preclude the activation of the consequence analysis alarm.

#### **4 IMCA DP BULLETIN**

The IMCA Marine DP Committee issue a DP bulletin four times a year covering the events that are happening in the industry. Check out the DP station keeping events page on the IMCA web site to see the latest events being reported to IMCA. Bulletins are available to everyone free of charge. Click here for the [link](#).