IMCA DP Station Keeping Bulletin 04/18

November 2018

The following event trees have been compiled from recent reports received by IMCA. The originators granted IMCA permission for the trees to be analysed and commented on by the IMCA Marine DP Committee. To ensure anonymity not all of the information contained in the original report was made available to the persons analysing these event trees.

Vessel managers, DP operators and DP technical crew should consider if these events and comments are relevant to their own vessel DP operation so that they can be used to assess and assist the safe operation of the vessel.

Any queries regarding this bulletin should be directed to IMCA Technical Adviser Andy Goldsmith (andy.goldsmith@imca-int.com). Members and non-members are welcome to contact Andy if they have experienced DP events which can be securely analysed and then shared anonymously with the DP industry.

Event 1: Isolation of Backup Supplies to DP Critical Equipment

Case Narrative

A DP 2 vessel was engaged in open water ROV operations with both ROVs and cranes in the water – the hook recovery was ongoing. The vessel was set up according to its critical activity mode (CAM) and, at the request of the end client, all identified cross connections were to be isolated. This included numerous backup supplies to a range of DP critical equipment. The vessel was being operated with two redundant groups.

The Event

The vessel suffered a partial loss of power from the port switchboard. This resulted in the loss of one redundant thruster group, one ROV and the main crane. The vessel maintained position post failure, allowing immediate investigations to take place in a controlled manor.

The Investigation

The ship's uninterruptible power supply (UPS) (for the failed redundant group) main supply change over switch was found in the 'emergency' position instead of the 'main' position. As a result of the isolation of backup supplies, the UPS batteries had effectively discharged, and supplies failed thereafter causing the DP event. The UPS switch was selected to 'main', which repowered the UPS to allow reinstatement of the redundant thruster group and mission related consumers. Further investigation revealed that the position of the UPS supply switch was not part of the DP system setup checklist, nor was it highlighted as a critical setting within the CAM configuration.

The Lessons

1) Any modification to a worse-case failure design Intent (WCFDI) configuration (which has been proved through the DP failure modes and effects analysis process (FMEA)) must be managed under a robust management of change (MoC) process with appropriate checks identified and undertaken. When clients are requesting particular operating modes of vessels, then the MoC process needs to also consider the DP FMEA and all associated operational criteria.

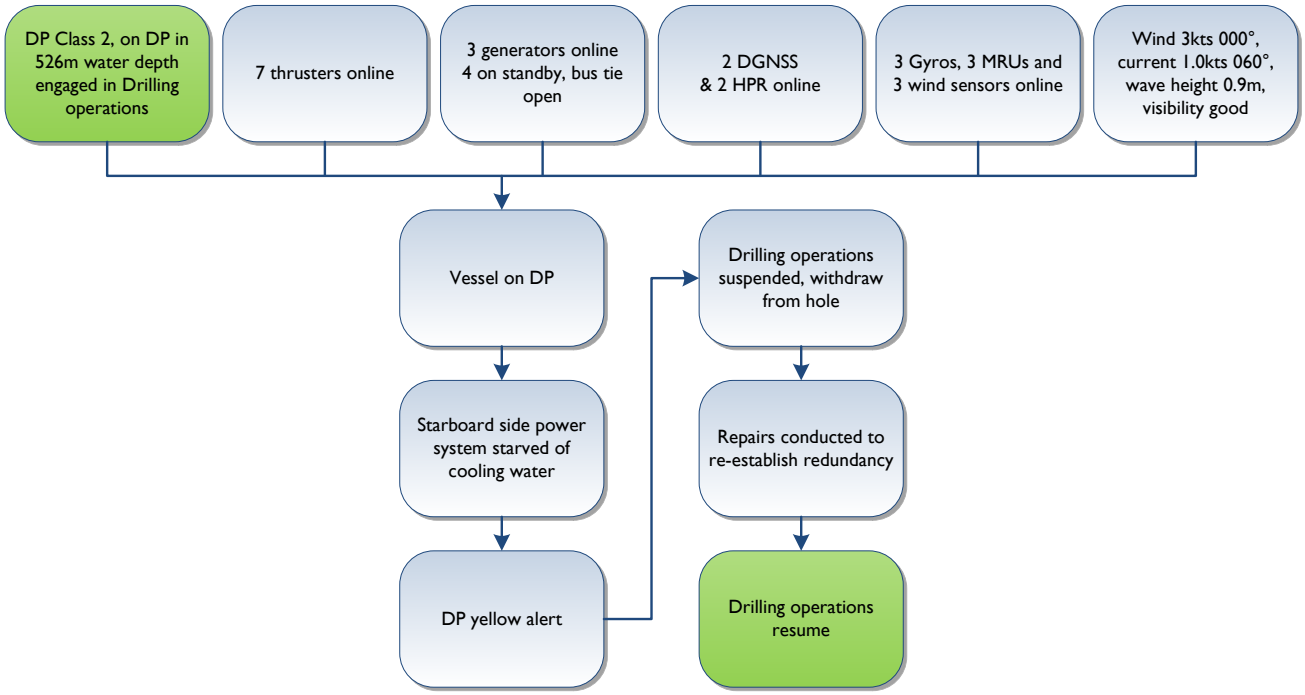
2) A periodic review of the completeness of operational checklists prior to and during DP operations to ensure that the vessel is operating as designed is essential.

3) In conjunction with lesson 2, it is vital that all equipment that has a selection choice is correctly labelled to clearly identify the selection and to avoid unnecessary confusion.

4) The actions of the crew coupled with the robust redundancy concept meant that the vessel operated as expected post event and during the immediate investigations thereafter.

This case study demonstrates the importance of robust consideration of requested mode changes that deviate from the vessels' failure analysis. It further highlights the importance of robust MoC procedures to understand the effects of the change on the equipment and/or redundancy concept.

Event 2: Inadequate Shallow Water Lay-up Reactivation Procedures



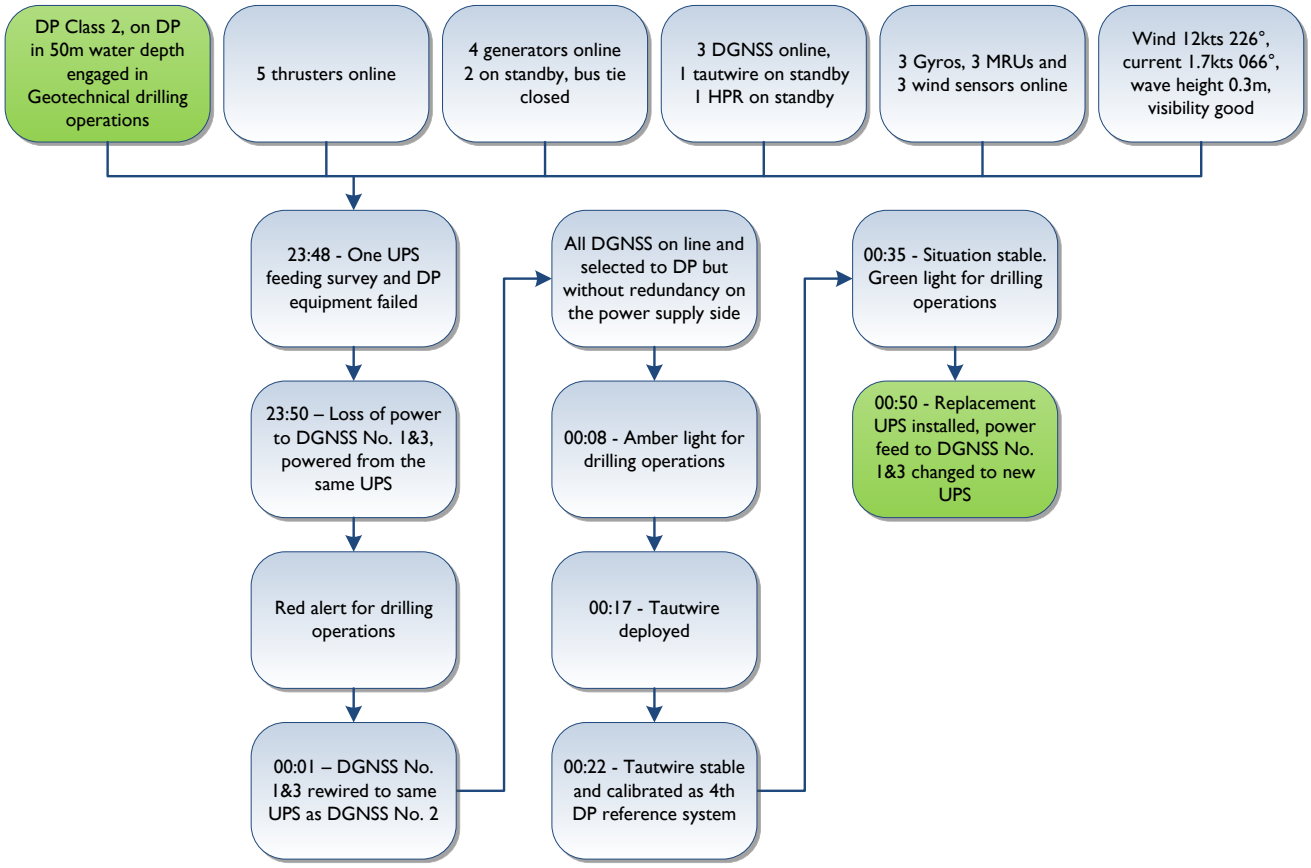
Comments from the Report

The heat exchange system is poorly designed and without redundancy for half of the switchboard. Design flaws were compounded by the introduction of turbidity and silt into the cooling system. The vessel was idle for some time in shallow water and the systems were not adequately preserved. There was biological fouling taking place on the heat exchangers. Although multiple heat exchanger cleanings had occurred, the system was not adequately flushed to remove the fouling.

Considerations of the IMCA Marine DP Committee from the Above Event

- The report indicates that although the cooling systems were cleaned prior to reactivation they had not been properly flushed and were therefore unable to perform to full capacity.
- It is important that all redundant systems are able to perform to full capacity following loss of a redundant group. If not, there is a potential to exceed the WCFDI following a failure.
- Performance tests should be part of the reactivation procedures after an idle period in shallow water.

Event 3: Use of Third-Party Equipment Leads to DP Undesired Event



Comments from the Report

The UPS and the DGNSS source does not fall under the vessel's planned maintenance system (PMS), as this is owned by the survey company. The equipment is maintained and tested before it is installed on a vessel. While the testing of signal dropout and UPS function is part of the vessel's DP checklists, there is no electrical maintenance or routine testing on the specific UPS while in service onboard; the backup strategy is to keep a spare UPS onboard.

Redundancies worked as designed; no critical situation developed. Drilling operations suspended purely due to loss of redundancy.

An additional checklist to routinely test the capabilities of the UPS was developed and implemented as part of the vessel PMS.

Considerations of the IMCA Marine DP Committee from the Above Event

- The online position reference systems (PRSs), 3 x DGNSS, do not provide adequate redundancy according to industry guidance;
- Considering the time taken to select the taut wire it appears ‘stand-by’ meant that the depressor weight was still on deck and not deployed;
- Reference should be made Guidance on operational activity planning (IMCA M 220);
- The report indicates that two of the PRSs were supplied with power from a UPS that was not designated for the DP system;
- The DP FMEA should be revisited to verify the effects of failures of the DP UPSs and the power distribution supplying the UPSs. It should be verified that the arrangements, the UPS endurance and the PRS set up for the industrial mission are in accordance with the DP Class 2 requirements;
- DP equipment should not be repaired and brought online after repair without being suitably tested;

- A proper assessment should be made, and MoC procedure followed when connecting third party equipment to the DP system;
- Reference should be made to Guidelines on the shared use of sensors for survey and positioning purposes (IMCA M 235).

Event 4: Position Reference Systems – A Timely Reminder

The IMCA Marine DP committee has identified a trend of DP station keeping events relating to the incorrect use or selection of PRSs. Events reported to IMCA include incidents, where station keeping capability has been lost and undesired events where redundancy has been compromised.

Recent Events Reported to IMCA Include the Following Learnings:

- Incorrect selection of PRSs – the requirement for at least two different principles not being followed leading to position instability;
- Over reliance on one PRS, Global Navigation Satellite system (GNSS), to the exclusion of others:
  - intermittent DGNSS signal outages in certain geographical locations
  - use of GNS without differential correction
  - common mode failures of DGNSS caused by selection of hardware from single supplier and differential positioning services from one supplier
  - DGNSS signal reception becoming unsteady because of either shielding or shadowing;
- DP reference sensor UPS supplies not following the redundancy concept of the vessel – loss of UPS led to no references online;
- During cargo operations, removal of relative positioning system transponders/reflectors by installation crew prior to station keeping activities being completed;
- Laser based system locking onto a crew member standing close to the reflector (in a restricted area);
- Incorrect selection of PRSs for the mission requirements;
- Poor MoC processes leading to loss of redundancy of Position Reference Sensors – rewiring of sensors post worst-case failure to finish the mission;
- Incorrect PRS selection for use at a mobile installation leading to conflict between absolute and relative sensors causing drift off;
- Feed from the GNSS to the gyro leading to inaccurate latitude and speed correction signals;
- Poor MoC leading to the antenna of one GNSS being connected to two GNSS systems, creating a common mode failure;
- Select the most suitable reference origin considering the mission to be completed;
- In the case of instability, know the manufacturer's procedure for resetting the reference origin;
- Make sure to fully understand the different tests carried out on each PRS and the actions to be taken when a test suggests that a position measurement is not accurate.

IMO Guidelines

The guidelines for vessels with DP systems (MSC/Circ.645) were approved by the IMO Marine Safety Committee (MSC) meeting 63 in May 1994 to provide the industry with an international standard for DP systems on all types of vessels. From these guidelines, classification societies create the rules with which DP vessels are designed and built.

IMO MSC/Circ.645 was updated in 2017 by IMO MSC/Circ. 1580 for new vessels and units with DP systems. This new circular provides an amended standard reflecting the development in DP operation since 1994 and current DP technologies. For vessels and units constructed on or after 1 July 1994 but before 9 June 2017, the previous version of the guidelines (MSC/Circ.645) may continue to be applied, however it is recommended that section 4 (operational requirements) of the present guidelines be applied to all new and existing vessels and units, as appropriate. The table below identifies the requirements of the two guidance documents with respect to PRSs and external sensors:

			IMO MSC Circular 645/IMO MSC Circular 1580 *MSC/Circ.645 6 June 1994 / MSC/Circ.1580 16 June 2017*		
Subsystem or Component			Minimum Requirements for Equipment Class		
			DP Class 1	**DP Class 2**	**DP Class 3**
Sensors	Position reference system (PRS)		$2^{(1+3)}$	$3^{(1)}$	$3^{(1)}$ 1 in alternate control centre
	External sensors	Wind	1	$3^{(2)}$	$3^{(1)}$ 1 in alternate control centre
		Heading reference sensor	1	$3^{(2)}$	$3^{(1)}$ 1 in alternate control centre
		Motion reference sensor	1	$3^{(2)}$	$3^{(1)}$ 1 in alternate control centre
Comments: **(1) Based on at least two different principles and suitable for the operating conditions** **(2) Based on three systems serving the same purpose** **(3) Only within MSC/Circ.1580 16 June 2017, otherwise not specified.**					

There are some other specific functional requirements set out in the latest IMO guidance related to PRSs and external sensors as follows:

- The reference systems and sensors should be distributed on the UPSs in the same manner as the control systems they serve, so that any power failure will not cause loss of position keeping ability;
- New requirement for equipment Class 1 vessels:
  - for equipment class 1, at least two independent PRSs should be installed and simultaneously available to the DP control system during operation;
- Further emphasis of the isolation required for equipment class 3 vessels:
  - for equipment class 3, one of each type of sensor should be connected directly to the backup DP control system and should be separated by an A-60 class division from the other sensors. If the data from these sensors is passed to the main DP control system for their use, this system should be arranged so that a failure in the main DP control system cannot affect the integrity of the signals to the backup DP control system.

The IMO guidance document does not specifically address mission requirements. It is the responsibility of owners and operators of vessels to ensure that their vessels are equipped with the appropriate PRSs for the missions they intend to undertake.