IMCA DP Station Keeping Bulletin 03/20

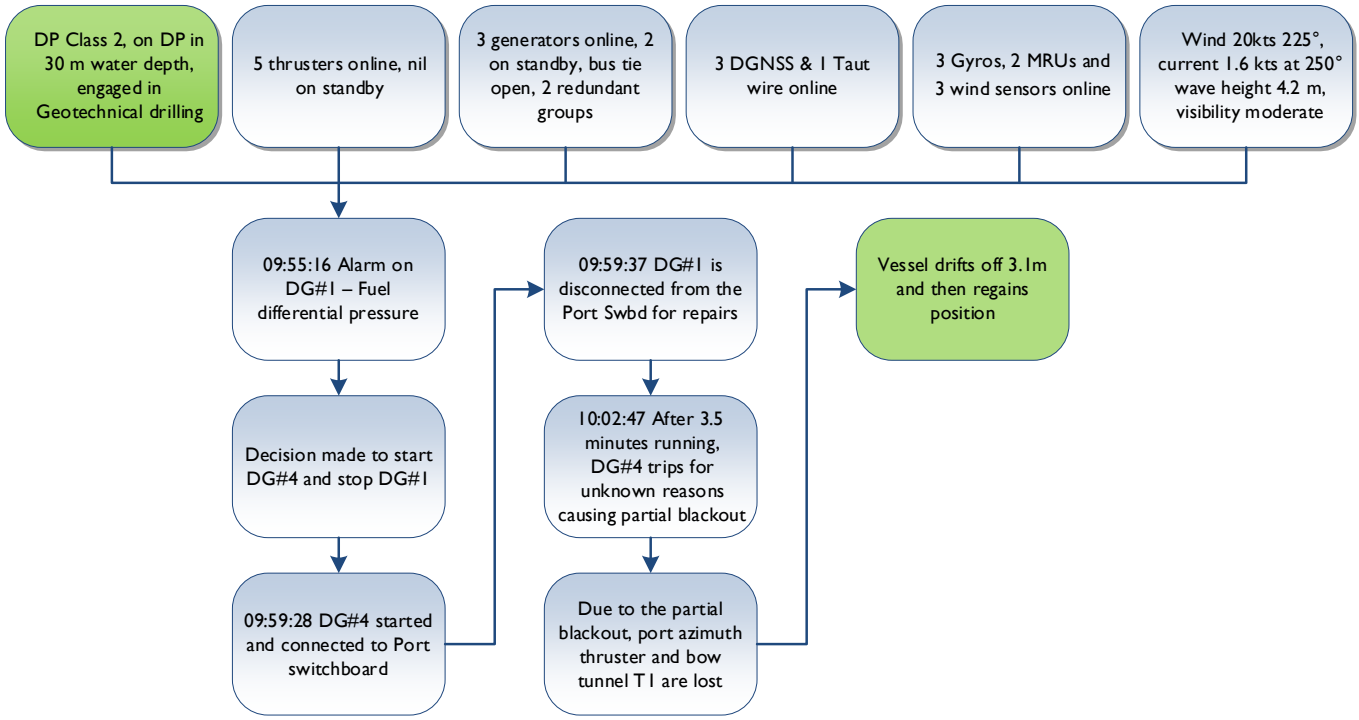
September 2020

The following case studies and observations have been compiled from information received by IMCA during 2020. To ensure anonymity all vessel, client and operational data has been removed from the narrative.

Vessel managers, DP operators and DP technical crew should consider if these case studies 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 Andy Goldsmith (andy.goldsmith@imca-int.com), IMCA Technical Adviser - Marine. Members and non-members alike are welcome to contact Andy if they have experienced DP events which can be securely analysed and then shared anonymously with the DP industry.

DP Incident Caused by Human Factor



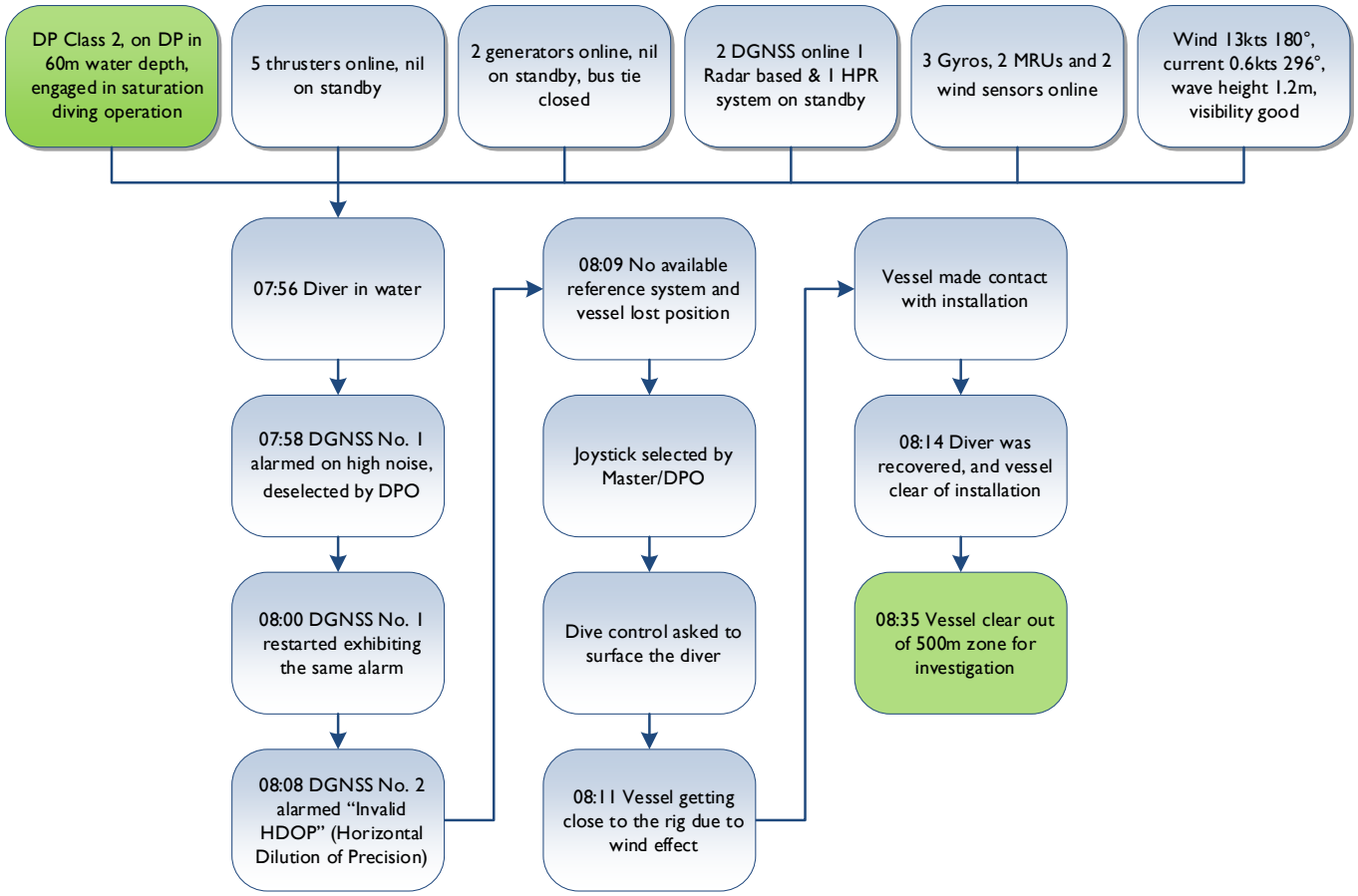
Comments from the report:

It is mentioned in the report that DG#4 tripped out for unknown reasons. Elsewhere in the report the cause of this incident is mentioned as complacency or lack of knowledge with DP redundancy concept.

Considerations of the IMCA Marine DP Committee from the above event:

- The set-up of the PRS was such that the DGNSS had the majority of the "PRS Weight" calculation in the DP controller, which is not recommendable.
- When a fuel filter differential pressure alarm is received, ensure that the correct procedures for filter changeover and filter replacement are carried out as soon as reasonably practicable. Always ensure that standby diesel generator is checked to ensure continuous service.
- The excursion was 3.1m but it should be noted that this is 10% of the water depth and could have been critical depending on the industrial mission.
- There is no mention of the DP watch circle in the report. It is particularly important that an Activity Specific Operating Guidance (ASOG) document is compiled and utilised for all DP operations, in accordance with IMO Circular 1580, chapter 4, see IMCA M 220 Operational Activity planning.

Lack of Operational Planning Leads to DP Incident



Comments from the report:

It was concluded that the loss of both DGNSS were due to huge superstructure of the installation interfering with satellite signals. This phenomenon is called reflection meaning DGNSS picks up reflected signals from the surroundings.

Considerations of the IMCA Marine DP Committee from the above event:

- The vessel was not being operated as a DP Equipment Class 2, as the requirement is at least three independent position reference systems should be installed and simultaneously available to the DP control system. Reference IMCA M 252 Guidance on Position Reference Systems and Sensors for DP Vessels.
- Loss of more than one DGNSS position reference system is a well-known issue due to external common cause failures, for example shielding of reference satellites and/or differential corrections.
- Operational planning and decision support tools, such as Activity Specific Operating Guidelines (ASOG), were clearly not in use or were inadequate. Reference IMCA M 220 Rev 1 provides Guidance on Operational Activity Planning.
- It appears that the DP Alert system was not used.
- It is mentioned in the report that at 08:09, master takes control of the vessel by the IJS. It is unclear from the report why the vessel then made contact with the installation. Reference IMCA M 117 The Training and experience of Key DP personnel.

♦ This event clearly demonstrates the benefit that can be gained from regular DP exercises and drills.

Loss of Gyro Input Causes Loss of Position

Case narrative:

A DP 2 vessel was involved in ROV operations in deep water with good visibility. The environmental conditions were moderate with a wind speed of 15 Knots and a current speed of 1.2 knots during the time of event. The vessel was operating in open bus tie mode with two redundant groups. There were five (05) thrusters and four (04) generators installed on the vessel and all were selected to DP. There were three (03) gyros, two (02) position reference systems and two wind sensors available and all selected to DP.

The following diagram depicts the system configuration prior to the event:

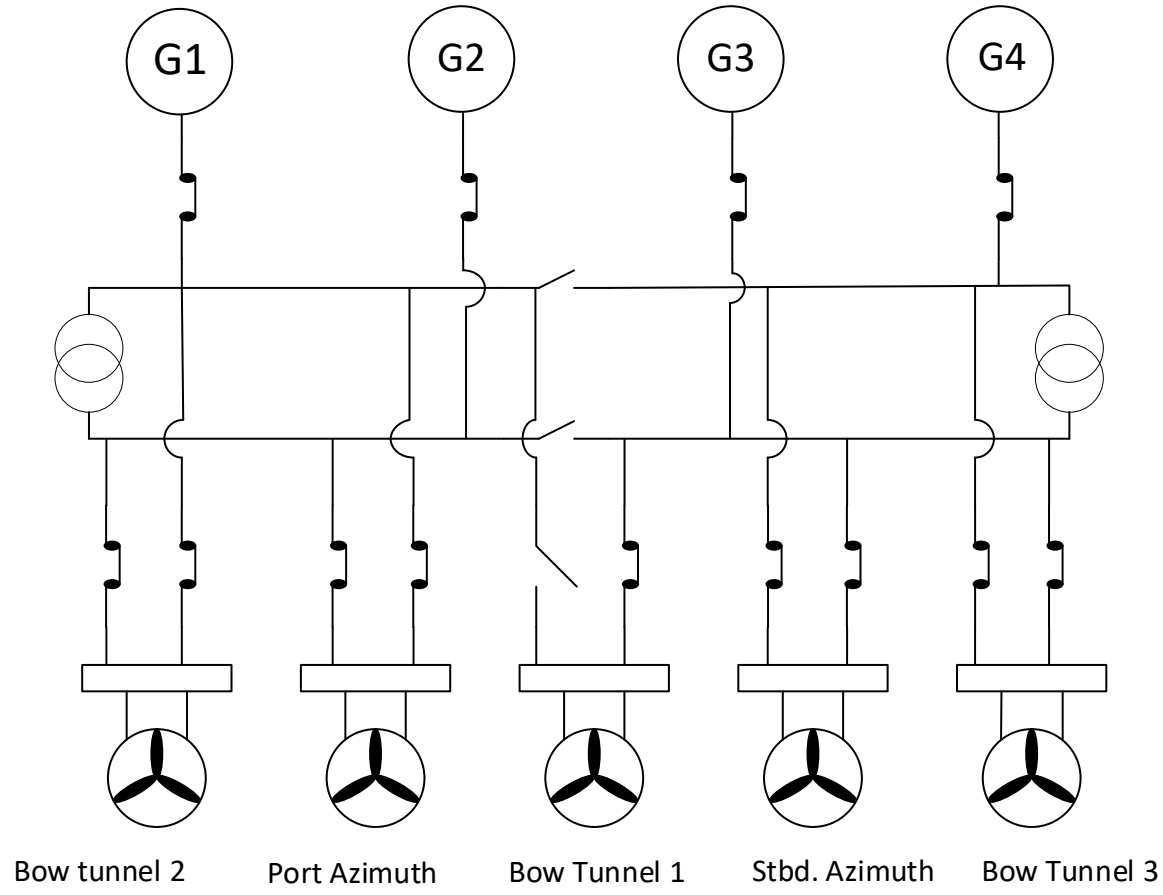


Figure 1 Vessel power system configuration

The event: An alarm "Gyro 2 Not Ready" appeared and gyro 2 was automatically deselected from the DP system. Immediately after this, gyro 1 also dropped out with alarms, "Gyro 1 Not Ready" and "Gyro 1 Heading Dropout". Within one second the third gyro failed with the following alarms in succession, "Gyro not enabled", "All Reference systems rejected" and "Position Dropout".

It was noted that gyro 1 repeater on the bridge continued to display the correct heading, while heading input from gyro 1 was missing at the DP operator station (OS). Concurrently, it was further noticed that gyro 2 repeater was in alarm with no heading display and gyro 3 was displaying the heading with 10 degrees offset. Orders were given to recover the ROVs on deck and the vessel control was transferred to full Manual mode.

The crew managed to get the vessel back to full DP control within twenty-eight (28) minutes from the onset of the first failure with one hundred and fifty (150) metres of uncontrolled movement during that time.

The following actions were executed:

- Gyro 2 restarted, rebooted and realignment completed
- DP OS 1 & OS 2 soft rebooted
- Controllers A & B of OS 1 rebooted after which all PRS and DP sensors online and enabled

The investigation revealed that gyro 2 was lost due to the loss of its Interface and Power Supply Unit. After replacing this unit, a test was carried out to prove the independence of gyro 1 from gyro 2. On disconnecting the power supply to gyro 2, it was observed that gyro 1 was also lost. Further system analysis concluded that the gyro 1 ready signal was linked with that of gyro 2 in the DP controller cabinet. This cross-connection issue caused a detrimental effect on both gyros' performance. In addition, following a malfunction on any gyro, the No. 1 Control and Display Unit would force the gyro 1 ready signal to disappear at the DP operator station. These issues were corrected and tested to the satisfaction of all involved parties.

During the time of the incident gyro 3 sensor value was found to be approximately ten (10) degrees different from gyro 1 and gyro 2 headings. When both gyros 1 and 2 were deselected from DP, gyro 3 was selected to the DP system. However due to the large deviation in the heading value of gyro 3 compared with the estimated heading, which in this case should not have been more than two degrees, the DP controller rejected gyro 3.

The lessons

- If a gyro has a static deviation from other gyros, this should have been identified, investigated, and rectified so that all gyros' measured headings are within the DP control system limits to avoid any such problems
- The common mode failure related to the ready signal of gyros' 1 and 2, should have been identified during commissioning, FMEA proving trials and DP annual trials programme. IMCA documents M 166, "Guidance on Failure Modes & Effects Analyses (FMEAs) and M 190, "Guidance for Developing and Conducting DP Annual Trials Programmes", underline the importance of having robust FMEA and set of annual trials
- IMCA M 252 "Guidance on Position Reference Systems and Sensors for DP Operations" provides general information on use of reference systems and the good practice of multiple references and sensors
- Importance of proper investigations and robust testing of cross connections in redundancy groups of DP vessels is highlighted in this case study

This case study demonstrates the importance of robust testing procedures during FMEA proving trials, annual trials or 5-yearly trials program. The case study also highlights the importance of conducting daily compass checks and completion of all other operational checklists so that differences in redundancy groups are identified early and can be corrected.

DP Emergency Drill Scenario

DP emergency drill scenarios are included to assist crew members conduct DP drills onboard. The intent is that the template can be used on any DP vessel so specific details regarding the technical outcome are not included. The benefit from using this template is to monitor and learn from the human reactions of key DP personnel. It is also important that the crew are familiar with various DP system setups including their failure modes. IMCA M 252 "Guidance on Position Reference Systems and Sensors for DP Operations" can be used for reference. This will improve the crew competence to handle such events and assist to improve processes, procedures, and post failure scenarios.

EXERCISE SCENARIO LOSS OF ALL POSITION REFERENCE SYSTEMS

Objective:

To identify risks of this occurrence, possibilities to reduce that risk and suitable actions if such an occurrence happened.

Method:

With the vessel in full auto DP control; power plant configured according to the vessel's DP FMEA and DP operations Manual (and respective decision support tool); all other vessel equipment and systems set up in accordance with applicable DP checklists:

1. Vessel in a safe location. Simulated location and activities agreed and communicated to all participants.
2. Simulate the loss of all PRS by deselecting them all from the DPC.
3. Check the vessel ability to maintain position using mathematical model.
4. Check the vessel crew ability to maintain position using DP joystick/IJS/manual control of thrusters.
5. **Evidence from DP station keeping event reports show that the simultaneous loss of all PRS continues to occur**. Discuss the results and determine how the risk of losing all PRS at one time could be mitigated.

Prior to executing, discuss the expected results:

- Is the methodology appropriate to gain the best outcome of the exercise?
- Who will be involved with the exercise and what roles will individuals have?
- What equipment will be impacted?
- What are the risks of the exercise?
- Is the exercise scenario appropriately documented?
- Who will observe and accurately record exercise data including the DP system configuration pre exercise?
- What is the anticipated loss of position?

Observations During Exercise:

1. Is the drill procedure being followed?
2. Is the equipment reacting as expected?
3. Are those individuals directly involved in the exercise reacting appropriately given their assigned duties?
4. Are those individuals indirectly involved reacting in an appropriate manner?
5. Is the degree of participation and diligence as expected?
6. What is the actual loss of position?
7. What is the duration from commencement to concluding a safe outcome for the vessel?

Actual results witnessed:

EXAMPLE: Weather recorded at time of exercise - wind, wave height, current.

The vessel maintained position within acceptable limits for xx minutes.

The procedure for changing from DP control to IJS was reviewed and worked well, position and heading were maintained within the following limits ….

EXERCISE SCENARIO	**LOSS OF ALL POSITION REFERENCE SYSTEMS**

Discussion Points (Post exercise):

Human Factors

- What are the potential risks due to "multi-tasking" during DP operations that may directly lead to the scenario outlined during this drill? (Examples include managing / monitoring deck operations, radio traffic, etc.)
- What are the potential risks due to distractions in the workspace (i.e., Bridge, Engine Room) that may directly lead to the scenario outlined during this drill? (Examples include routine maintenance procedures, social media, personnel interactions, etc.)
- Discuss the alternative actions/reactions that may occur in response to a similar scenario. Are there multiple paths to a successful resolution or is there a preferred solution? Why?
- Following a review of the simulated exercise and the vessel and crew's reaction, what different operator (Bridge and/or ECR) reaction(s) might be warranted if faced with a similar situation during operation?

Review of DPO and other key DP personnel reaction

- What potential gaps in the existing DP Familiarisation program have been highlighted as a result of the exercise?
- What changes/revisions should be considered for the training and familiarisation procedures?

Review the applicable checklists (ASOG CAM/TAM/DP operations Manual/bridge and engine room checklists/ FMEA/DP Annual Trials programmes/etc.)

- What additional necessary actions and considerations should be addressed?
- What potential changes should be made to make the checklists more appropriate?
- What additional necessary operating conditions and parameters should be considered?
- What potential changes should be considered to make Decision Support Tools more applicable to the vessel and her equipment?
- How would these changes improve/affect the vessel's capabilities and limitations?

Conclusion:

Based on the results of the exercise and related discussions before and after, any suggestions for follow up including any corrective actions deemed appropriate should be accurately detailed and managed to close out.

Handling of PRS failures in the correct manner requires knowledge of the individual sensors and PRS and how the DP controller is handling the inputs, items to consider include:

a. Basic PRS principles
b. Potential cause for error and disturbance
c. PRS Parameter settings and active logging
d. Redundancy configuration
f. Sensor and PRS handling within the DP controller
h. Parameter settings in the DP controller (for example "Reduced GPS weight")
i. What to look for on the HMI
j. What event and alarms indicate PRS trouble
k. Controller logic in rejecting PRS
l. Methods of fault finding and investigation