DP Event Bulletin

01-24 – March 2024

The following case studies and observations have been compiled from information received by IMCA. All vessel, client, and operational data has been removed from the narrative to ensure anonymity. Case studies are not intended as guidance on the safe conduct of operations, but rather to assist vessel managers, DP operators and DP technical crew in appropriately determining how to safely conduct their own operations. Any queries should be directed to IMCA at dpreports@imca-int.com. Members and non-members alike are welcome to contact IMCA if they have experienced DP events which can be shared anonymously with the DP industry.

List of DP Events

Figures

1 Closed Bus – PMS Failure Leading to Thrust Limitation of All Thrusters

1.1 Overview

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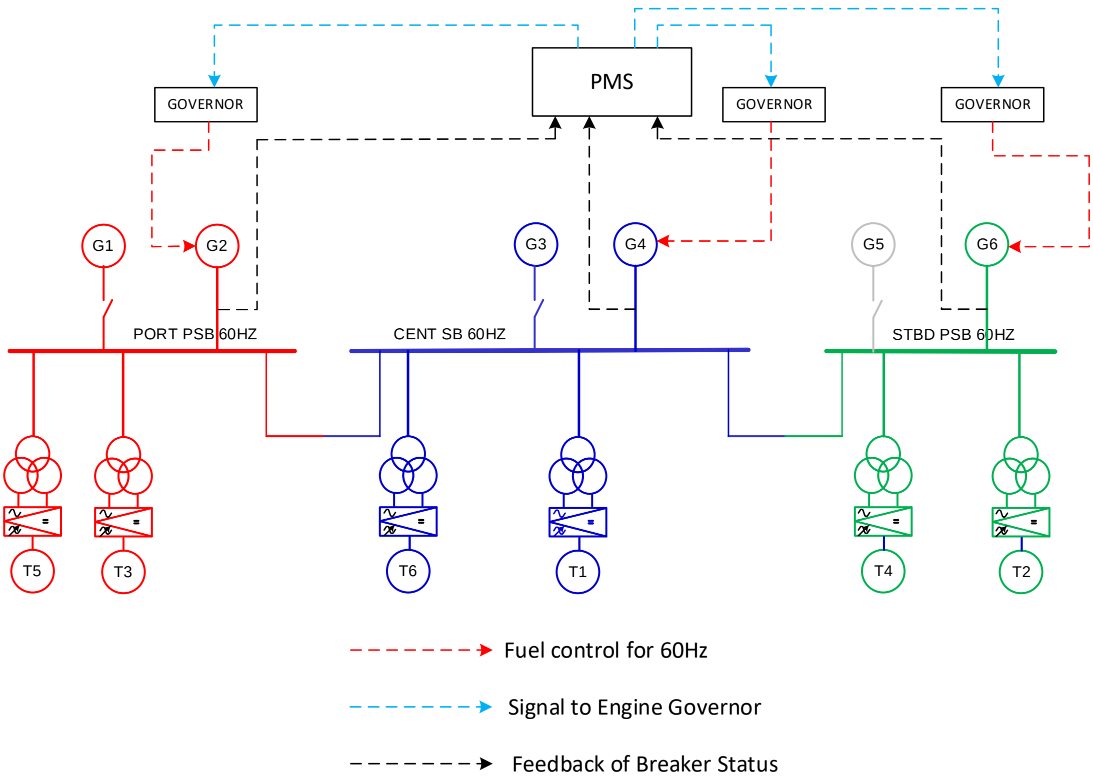

Figure 1 – Intact state prior to failure

The vessel encountered a critical situation due to a fault in the Power Management System (PMS). A malfunction in the Input/Output (I/O) module for the No. 4 centre generator triggered a series of events leading to a loss of vessel position and an emergency disconnect.

1.2 What Happened?

1) **Misleading Alarm and Response:** An alarm signalled a generator fault, leading the engineer to disconnecting the faulty generator by opening the circuit breaker but leaving the effected generator running. However, due to the I/O module fault, the breaker status incorrectly showed to the PMS as still closed/connected.

2) **I/O Module Fault:** The I/O module for the No. 4 centre generator developed a fault, causing the generator circuit breaker status to freeze in the 'closed' position when the breaker was physically opened.

3) **Load Sharing Imbalance:** The disconnection of the generator caused a load sharing imbalance. The PMS attempted to correct this imbalance, but as the disconnected generator could not take any load, the imbalance persisted. The PMS believed it was controlling three generators not two, the status signal was not just for indication but an important input to the PMS control. PMS lowered the fuel setting to G2 & G6 and increased fuel setting to G4.

4) **Bus Frequency Decline and Thrust Limitation:** The persistent imbalance led the PMS to reduce the bus frequency, eventually triggering a frequency-based thrust limitation function on all thrusters. This resulted in the loss of the vessel's position and necessitated an emergency disconnect.

   When a Power Management System (PMS) tries to manage three generators but only two are actually connected in parallel, while the PMS believes all three are connected, several issues can arise due to this discrepancy:

   a) **Load Sharing Problems:** The PMS is designed to balance the load across all connected generators. If it believes three generators are connected and operating, it will attempt to distribute the load across all three. However, since only two are actually connected, it will still try and load up the unconnected generator, which in this case meant lowering the governor setting on the two connected generators and raising the governor settings on the unconnected generator.

   b) **Voltage and Frequency Instability**: Generators in a parallel setup need to maintain synchronicity in terms of voltage, frequency, and phase. If the PMS tries to synchronise three generators but only two are present, it can lead to instability in voltage and frequency. In this case the two connected generators were 'slowing down' this had the effect of reducing the bus frequency, as the frequency detreated the thruster drives tripped on their protection settings. The unconnected generator was 'speeding up' and eventually tripped on overspeed.

   c) **Incorrect System Readings and Responses:** The PMS uses data from all generators to make decisions about load distribution, startup, shutdown, and other operational aspects. Incorrect data due to a non-existent third generator can lead to inappropriate decisions, such as unnecessary generator startups or shutdowns, or failure to start an additional generator when needed.

   d) **Protection System Mis-operation:** The protection systems in power management are designed to prevent damage to generators and connected systems in cases of faults. If the PMS incorrectly assumes the presence of a third generator, it may not correctly identify and react to real faults, potentially leading to equipment damage or safety hazards.

G4 eventually tripped off on overspeed, once this trip happened the 2 connected generators returned to normal load sharing and returned the bus frequency to 60Hz, however this was too late as the thrusters had already reduced their thrust output to zero.

The standby generators were prevented from connecting prior to G4 trip due to the low bus frequency. Once G4 tripped, the PMS return to normal load sharing and as the frequency returned to normal level the standby generators were able to connect.

Once the thruster drives detected the normalisation of the bus frequency the thrusters were able to return from phase back allowing DP Control.

The time duration was relatively short (approx. 3 mins) – however, the position excursion was in excess of 75 metres.

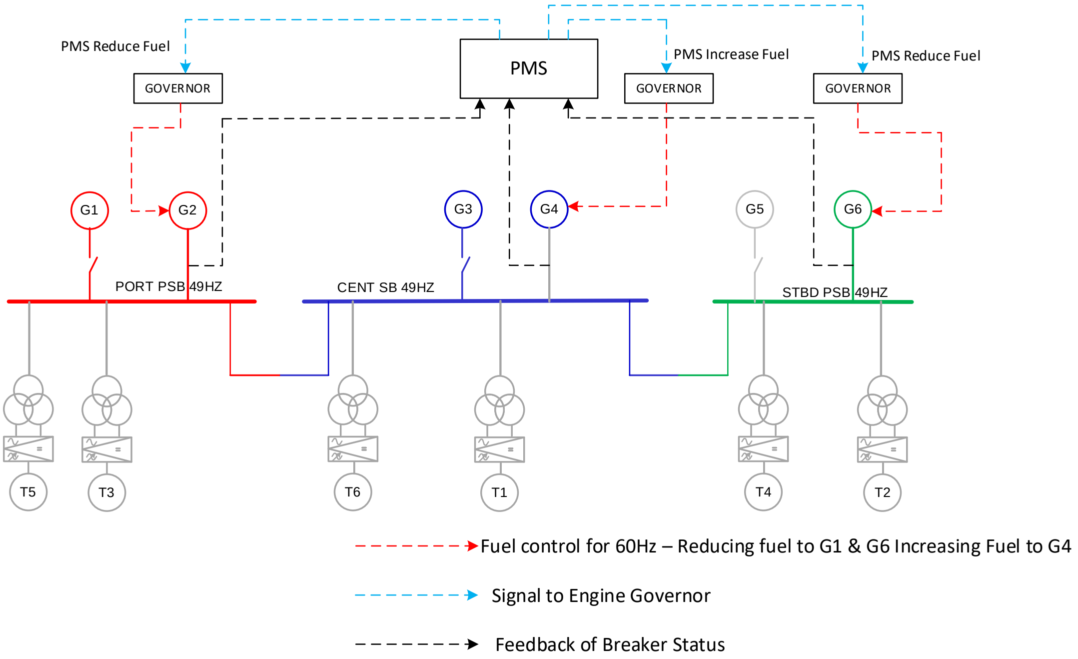

Figure 2 – During failure, thrusters phase-back on low frequency

1.3 Considerations

- **FMEA Inclusion of PMS Interface:** The vessel's Failure Modes and Effects Analysis (FMEA) should be revised to include the PMS interface, ensuring that similar failure modes are identified and mitigated.
- **Testing of PMS in Closed Bus Operations:** The incident suggests that the PMS was not adequately tested for operations in closed bus mode. Comprehensive testing in this mode is recommended to prevent similar occurrences.
- **Generator Protection Evaluation:** The occurrence of frequency issues points to a lack of advanced generator protection or its malfunction. This aspect must be investigated and rectified.
- **Review of Operational Manuals:** The vessel's Dynamic Positioning (DP) operations manual, Standard Operating Procedures (SOPs) and Well Specific Operating Guidelines (WSOG) should be reviewed and updated in light of this incident.

1.4 Conclusion

The incident underscores the criticality of robust PMS functioning in marine vessels, especially in complex configurations like closed bus mode. It highlights the need for comprehensive FMEA, rigorous system testing, and continuous review of operational procedures to ensure the safety and reliability of marine operations.

Additionally, the need for appropriate protective function related to load control (i.e. additional generator protection).

2 Button Trouble

2.1 Overview

A Dynamically Positioned vessel experienced a loss of dynamic positioning (DP) control while installing cable within a wind farm.

The incident occurred during the cable lay operation. The DP manual override command on the navigation bridge was inadvertently activated, which caused a loss of DP control over 6 of the thrusters, resulting in the vessel drifting off position.

Without forward thrust, the vessel was pulled astern by approximately 15 metres due to the action of the cable tensioners. This resulted in a section of the cable, approximately 36 metres in length, being damaged.

The bridge crew managed to manually regain DP control by returning each thruster to DP. The personnel in the working area were accounted for, with no injuries reported, and no damage to other assets or equipment was reported. The cable was secured and laid down in a controlled manner, and the vessel was relocated outside the windfarm to prevent further incidents. An investigation into the cause of the DP loss was initiated.

Figure 3 – Typical mode change button arrangement

2.2 Findings

Investigation revealed that this command was activated inadvertently, leading to the loss of thruster control.

The vessel's DP Control system was upgraded during a recent vessel life extension. Part of the upgrade included the addition of a manual override button.

2.3 Recommendations

- To prevent recurrence, the manual override button on the navigation bridge could be replaced and the single manual override functionality removed.
- Vessel owners/operators should assess their DP systems to eradicate such single action override buttons or ensure they are adequately protected.
- The crew's understanding of the DP functionality should be assessed, and additional training to be provided to ensure full comprehension of a new system.
- Emergency drills should be conducted to ensure crew preparedness for various scenarios.
- The DP checklist should reflect the change to the Master's DP standing orders.
- Due to system upgrade, MOC needs to be put in place and to be included in the handover note. Familiarisation to highlight changes which occurs during system upgrade.

2.4 Conclusion

This case highlights the critical importance of thorough testing and crew training following the integration of new systems or functionalities on vessels. The incident underscores the potential risks associated with manual overrides and the necessity for stringent controls and fail-safes to prevent inadvertent activations.

3 Push/Force Off

3.1 Overview

This case study examines an incident involving a vessel during cargo operations adjacent to a fixed platform in the North Sea. The event in focus is a push-off incident, where the vessel collided with the platform during a pause in operations.

3.2 What happened

The incident occurred while the vessel was engaged in the transfer of cargo. During this process, the vessel was operating under fully automatic Dynamic Positioning (DP) Mode. Given the smooth progress of operations, the vessel was instructed to maintain a standby position for approximately one hour, positioned marginally upwind of the platform.

The Dynamic Positioning Operator (DPO) made the decision to deselect the automatic Surge function on the DP system, opting instead to manually control the surge axis using a joystick. This decision became critical as weather conditions began to deteriorate progressively. In response to the changing weather, the DPO manoeuvered the vessel's bow into the wind and waves to maintain position effectively.

However, when the vessel was approximately 20 metres from the platform, it encountered a sudden and significant escalation in environmental forces. The rapid onset of these conditions exceeded the DPO's capacity to react promptly, resulting in the vessel being pushed into the platform, culminating in a collision**.**

3.3 Conclusion

In retrospect, given the knowledge of a minimum one-hour standby period, it would have been more judicious for the vessel to reposition to a safer blowoff position. This strategic relocation could have potentially mitigated the risks associated with environmental forces.

A critical aspect for analysis is the decision to deactivate the automatic surge functionality of the DP system. This action necessitated manual intervention by the DPO to apply appropriate forward thrust via the joystick, counteracting environmental forces acting on the vessel. The reliance on manual control in dynamically changing weather conditions presents a significant risk factor that warrants further examination.

The lessons learned from this incident emphasise the importance of anticipatory positioning in response to known operational pauses, especially in environments prone to rapid weather changes. Additionally, the reliance on manual controls over automated systems in critical situations should be carefully evaluated to ensure optimal response capabilities under adverse conditions.

By deselecting the surge, the vessel cannot be qualified as being on DP but under manual control, which means that the Operator needs to be in attendance at all times. Gain of the Joystick will have to be adjusted as per weather condition.

Stand by rules, which exist with most of the charterer need to be fully understood by the DPO and reflected in Master DP standing orders. Vessels needs to be set up as per charter rules, in particular within the 500m zone.

4 The Cascade Effect

4.1 Overview

This case study examines a critical incident aboard a Dynamic Positioning (DP) vessel, five years post-construction, which experienced a significant power management failure. The incident unfolded during what was considered 'routine' maintenance in the engine room and led to a series of cascading failures impacting the vessel's power supply and propulsion control.

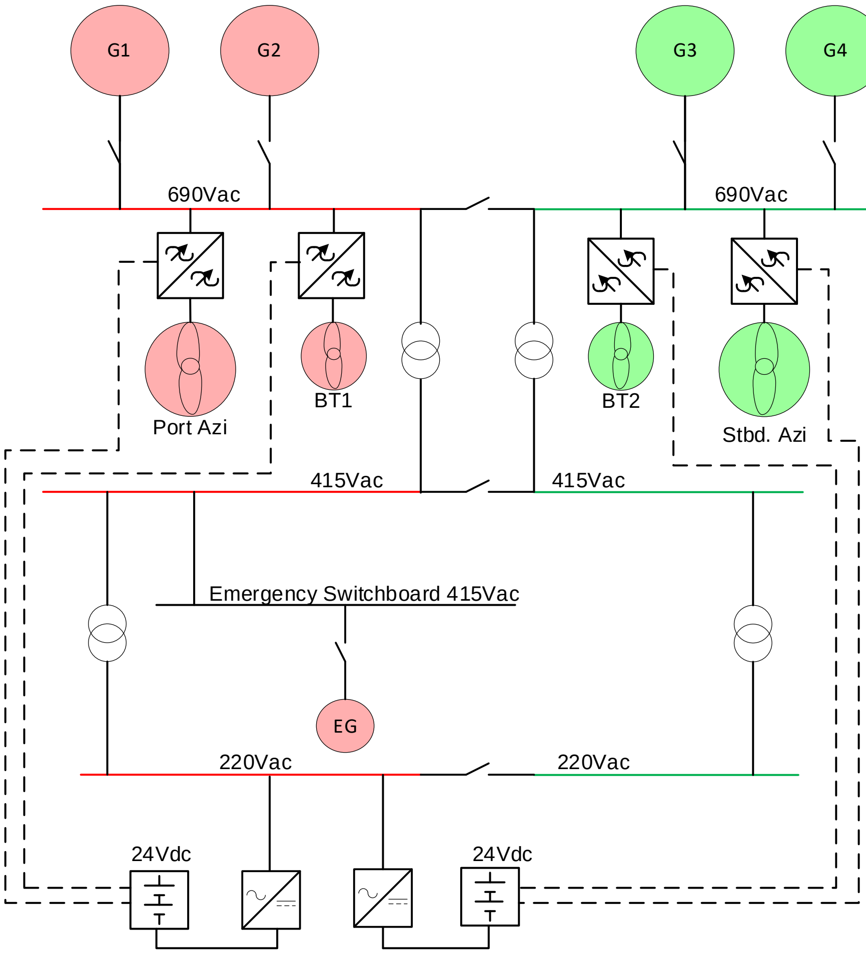

Figure 4 – Overview of power system

4.2 What Happened

The incident initiated when the engine room watchkeeper attempted to replace the left filter of the duplex fuel oil filter of Diesel Generator (DG) No. 1. This generator, integral to the port redundant system, was responsible for powering the 415v and 220v bus A and the emergency switchboards.

1) **Failure of DG No. 1:** Following the filter change, DG No. 1 experienced a blackout due to fuel oil starvation, attributable to incorrect operation of the duplex fuel filter.
2) **Inadequate Power Supply from DG No. 2:** DG No. 2, also part of the port redundant group, was initiated but failed to supply power to the bus.

3) **Emergency Generator Disconnection:** The emergency generator did not engage with the emergency switchboard as the breaker was inadvertently left in manual mode, resulting in a loss of power to the emergency bus bar.

4) **Battery Failure:** Control power for DP essential equipment, typically supported by batteries during such failures, was compromised as the batteries were drained.

5) **Design Flaw in Power Distribution:** Despite no failure in the starboard redundant group, the loss of all propulsion control power occurred due to a design fault. The 220v AC and 24v DC systems, providing control power for all propulsion, were sourced solely from the port redundant group.

This design flaw was not identified in the Failure Modes and Effects Analysis (FMEA) or during the annual DP trials, the most recent of which was conducted less than three weeks prior to the incident

4.3 Conclusion

This incident underscores the importance of thorough initial FMEAs, tracking modifications, and ensuring up-to-date documentation. It highlights the need for frequent testing of redundancy groups, implementation of a robust permit-to-work system, and the use of precise DP checklists in both engine room and bridge operations. The event serves as a critical reminder of the intricacies and potential vulnerabilities in power management systems on DP vessels, emphasising the need for diligent maintenance, rigorous testing, and proactive design reviews to ensure operational safety and reliability.

This incident underscores the critical importance of precise control and monitoring of DP system modes during sensitive offshore operations. The swift action by the DPO mitigated the potential risks associated with the unintended mode change. The subsequent software modification and procedural reviews enhance the safety and reliability of DP operations, emphasising the need for continuous vigilance and robust system controls in dynamic maritime environments. It also highlights the importance of robust procedures around field entry and activity specific guidelines.

In response to this incident, several corrective measures were undertaken:

- prohibition of maintenance on active or passive DP components within 500 metres of an installation
- to be indicated in the Engine Room DP checklist and handover checklist
- permanent modification of the switchboard setup to ensure propulsion control power is supplied from different redundant groups
- verification of switchboard setup by two separate watchkeepers
- regular DP blackout drills
- regular training on switchboard setup
- enhanced battery checks and testing routines
- review and update of the company's test and trials programmes.

5 DP Drill Scenario

DP emergency drill scenarios are included to assist DP vessel management and DPOs / Engineers and ETOs to 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 of 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 set-ups including their failure modes.

Refer to IMCA M117 *Code of practice for the training and experience of key DP personnel – Appendix 6*

EXERCISE SCENARIO ACTION REQUIRED DURING A DRIVE OFF FROM POSITION
Objective: To identify risks and impacts of this occurrence, possibilities to reduce that risk and suitable actions to be taken if such an occurrence happened.
Method: With the vessel in full auto DP control; power plant configured according to the vessel's DP operations manual (and respective decision support tool); all other vessel equipment and systems including position & heading references set up in accordance with applicable DP checklists: ♦ Vessel in a safe location. Simulated location and activities agreed and communicated to all participants. ♦ This scenario can be accomplished by initiating a large position move while in auto position at a high speed. Once the vessel has developed headway the DPO should demonstrate both bringing the vessel under control and moving the vessel away from danger using the IJS or DP joystick or the manual controls (practice using all 3 methods would be preferable). Another option could be to take a thruster to local control at the thruster room and generate maximum thrust, i.e. by operating the CPP pitch control valve or manually controlling the drive. ♦ Check that appropriate alarms are generated and that DP equipment temperatures and functions are within acceptable/ normal limits. ♦ Check the vessel DP crew ability to manage the situation in a controlled manner. ♦ Discuss the results and determine how the risks could be mitigated / managed.
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 / lost? ♦ What are the risks of the exercise? ♦ Is the exercise scenario appropriately documented? ♦ What will be the communication channels during the exercise? ♦ Who will observe and accurately record exercise data including the DP system configuration pre exercise? ♦ What is the anticipated loss of position? ♦ Are there any secondary failures expected? (for example, mission equipment)
Observations During Exercise: ♦ Is the DP emergency drill procedure being followed? ♦ Is the equipment performing / reacting as expected? ♦ Are those individuals directly involved in the exercise reacting appropriately given their assigned duties? ♦ Are those individuals indirectly involved reacting in an appropriate manner? ♦ Is the degree of participation and diligence as expected? ♦ What is the actual loss of position? ♦ What is the duration from commencement to concluding a safe outcome for the vessel? ♦ Was the communication effective during the drill?

EXERCISE SCENARIO	ACTION REQUIRED DURING A DRIVE OFF FROM POSITION

Actual results witnessed:

EXAMPLE:

The vessel maintained accurate station keeping with remaining online equipment.

The DP system reacted well, maintaining station keeping, as did the crew in responding to the failure.

The vessel DP system regained control returning to original position.

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 programme 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 vessel in the correct manner requires knowledge of the DP specific equipment, how the DP system reacts to scenarios and their respective alarms and the human intervention required if necessary to ensure station keeping. Items to consider include:

- appreciation of the potential to stop a thruster in emergency cases using the emergency stops
- how quickly would it be determined that this scenario constituted a "red" situation within the ASOG
- DP system reaction to multiple failures
- what to look for on the operator stations
- what event and alarms indicate any system failures
- methods of fault finding and investigation
- appropriateness of communication
- training requirements.

6 News in Brief from the DP Committee

- M140 *Specification for DP capability plots* is being updated
- M166 *Guidance on failure modes and effects analysis (FMEA)*

6.1 Station Keeping Events STATS

The information below is a snapshot of the DP Station Keeping Events to date for 2024.

How many in 2024

- Total 14 Reported to date

What type

- 01 Observation
- 12 Undesired Event
- 01 Incident

Bus Configuration

- 14 Open
- 00 Closed

Main Cause (Overall Effect)

- 0 Human
- 3 Computer
- 6 Thruster/Propulsion
- 0 Power
- 5 Electrical
- 0 External Factors
- 9 Position References
- 0 Environmental
- 0 Mechanical
- 0 Sensors

Secondary (Root) Cause

- 0 Human
- 2 Computer
- 2 Thruster/Propulsion
- 2 Power
- 6 Electrical
- 0 External Factors
- 1 Position References
- 0 Environmental
- 1 Mechanical
- 0 Sensors

The percentage of DP incidents (loss of position/heading) reported per year has increased since 2019, a year before the pandemic, which is a concerning trend. The 2022 figures showed that the percentage of incidents had decreased, and this was encouraging. However, 2023 showed an uptick, so far this year the rate is down, however, this is only representative of 14 reports to date.

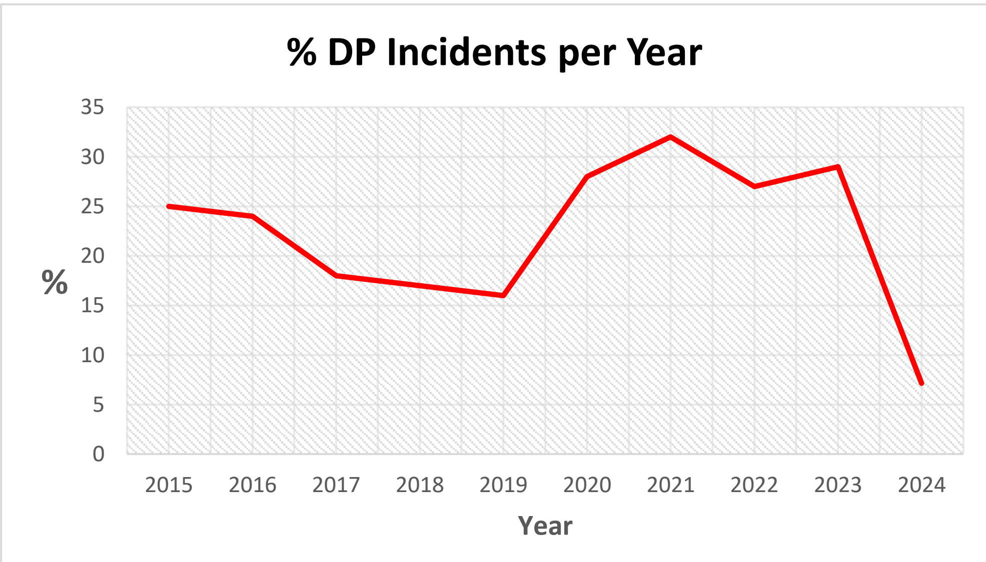

Figure 5 – Percentage of DP event reports received resulting in DP incidents (loss of position/heading)

Dynamic Positioning Station Keeping Review – Incidents and Events Reported for 2023 can be downloaded from our website.

If you are employed by an IMCA member company, you can register on the website using your company domain email address. Once registered, you will be given direct access to the members area including all guidance and publications. This also applies to Bridge, ECR or Rank email addresses onboard vessels.

The IMCA DP reporting form is available here. You may want to consider using this form for your vessels. Please forward reports to dpreports@imca-int.com.

6.2 Continuous Professional Development (CPD)

Following the announcement from the Nautical Institute (NI) about the new requirements for revalidating the DPOs Certificate, a Key DP Personnel continuing professional development (CPD) learning programme has been developed by IMCA and the NI to provide valuable CPD learning to DPOs who perform a safety critical role onboard offshore DP vessels.

The learning programme is accessible to all Key DP Personnel to ensure that their technical knowledge of the latest industry practices is up to date and measured though questions delivered through an application available on desktop and on mobile devices. This will ensure professional currency with the latest IMCA / industry guidance, DP safety bulletins, DP exercise and training drills, and help prevent knowledge and skill fade in the various DP-related roles on vessels.

The content has been designed for use on mobile devices. The delivery of the content is through the EdApp application software which is a mobile device learning management software. The application is available across a wide range of operating systems – for example, IoS and Android – and the app functionality provides offline capability meaning the content remains available without internet connection, an important factor for seagoing personnel.

Registration and payment for the app is undertaken via the NI Alexis Platform which is accessible by all Key DP Personnel who wish to purchase the CPD programme.

Find out more @ https://www.imca-int.com/certification/dp/cpd/.