IMCA DP Station Keeping Bulletin 02/20

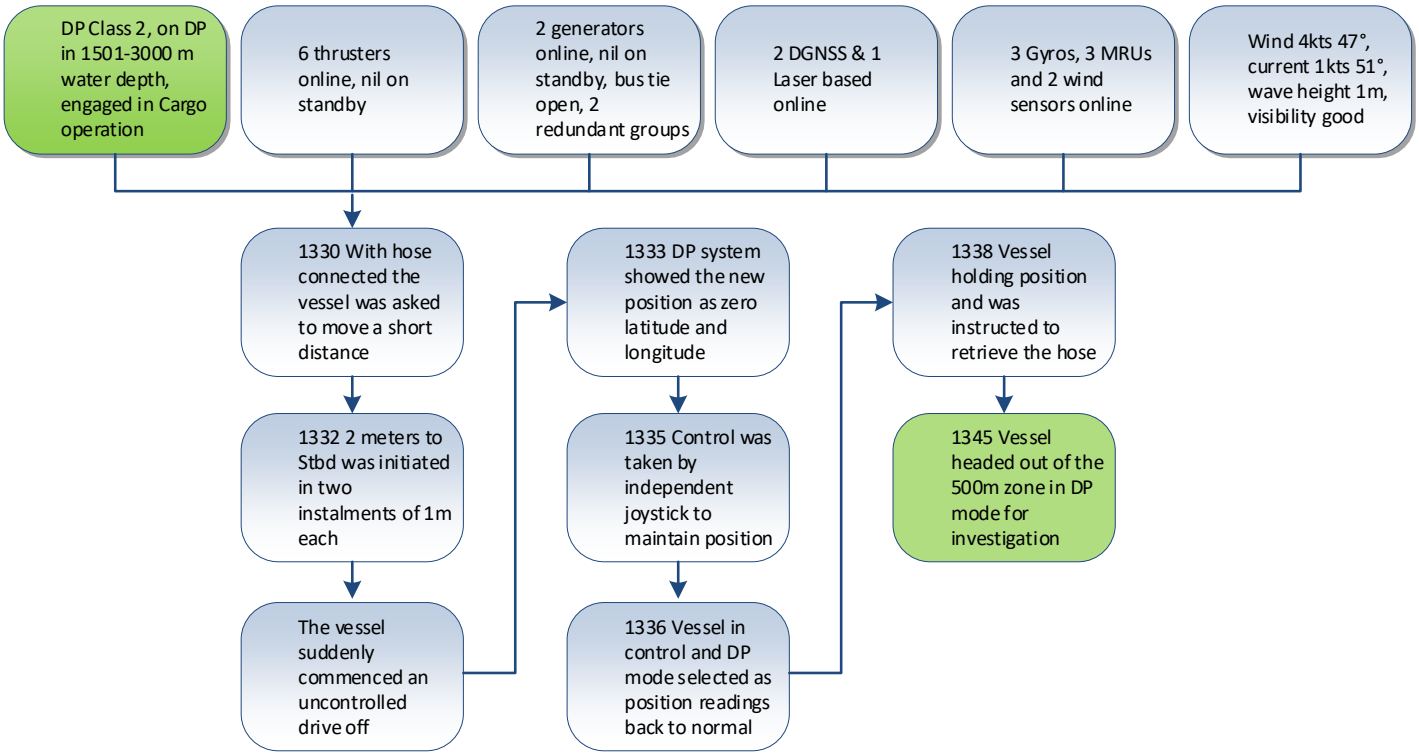
May 2020

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 Software Glitch



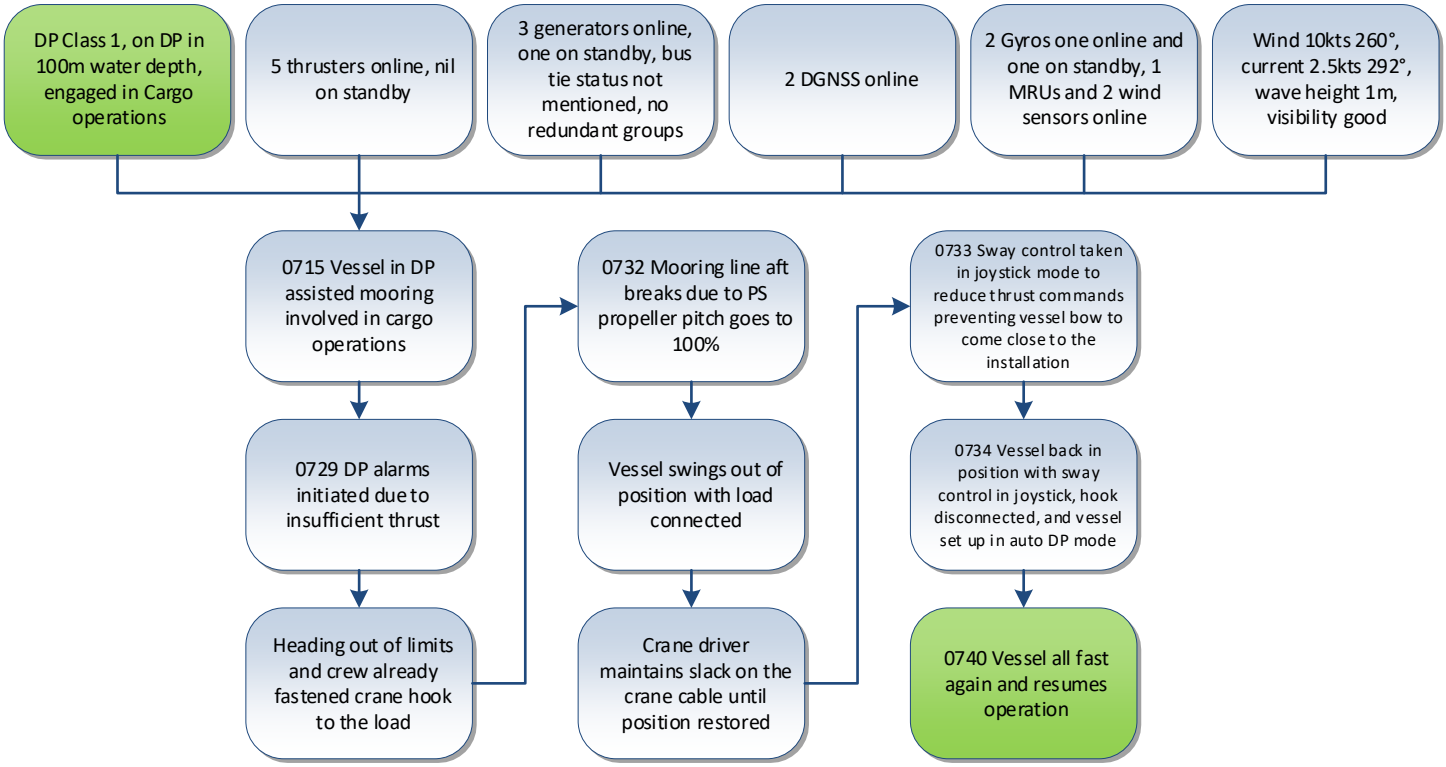
Comments from the report:

The two meters move command was given in two one-meter steps to the DP system by the operator with a time lapse of a few seconds. This was investigated by the DP system vendor and was identified as a software glitch. Two consecutive incremental move commands before the window screen has time to refresh resets the DP system to a zero position automatically. Instructions were put in place on-board this and similar vessels until the vendor remedies the software issue.

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

- This and similar incidents highlight the need for extensive testing of the software at all stages;
- Many vendors continuously update their software with patches, revisions, etc. Vessel operators must ensure a robust management of change (MoC) procedure and suppliers should provide an appropriate rigorous testing program;
- The DP operator(s) appear to have initially responded well to the incident and this is a credit to their training and competence;
- Reference IMCA documents Guidance for developing and conducting DP annual trials programmes (IMCA M 190) and Guidance on failure modes and effects analysis (FMEA) (IMCA M 166).

DP Incident with Assisted Mooring



Comments from the report:

During cargo operations in DP assisted mooring, due to undefined information being fed to the DP system, the pitch on the port propeller increased to maximum. The vessel started to drive off the installation with the crane connected to the load, dimensions 3.5*10.5*6.5 m weighing 11 M Tons. All deck crew were already in safety area behind crash bar ready with tug lines for the lift.

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

- There appears to be no consideration to the external force being applied to the vessel due to the use of mooring lines when in DP;
- If an external force is applied to a DP vessel without feedback and correct configuration within the DP system, it will have unintended consequences;
- It appears an appropriate Activity Specific Operating Guideline (ASOG) was not in use.

DP2 Semi-submersible MODU DP Incident

Case narrative:

A DP2 Semi-submersible mobile offshore drilling unit (MODU) was working in field preparing for drilling operations on location. The environmental conditions at the time were benign. Cargo operations were ongoing with a DP2 platform supply vessel alongside.

The vessel experienced a total loss of all online thrusters leading to the MODU starting to drift. The power management system standby started offline generators; however, it could not re-engage thrusters to DP automatically. The supply vessel was ordered to relocate out of the 500m zone, and the crane driver instructed to lower the crane boom to rest.

With no thrusters available the vessel drifted before the DPOs were able to start three previously offline thrusters manually, which were then selected to DP. Subsequently, the Electrical Technical Officer reset a further two thrusters locally allowing them to be selected to DP control. Within 3 minutes a sufficient level of thrusters were online and station keeping was stable. Within 17 minutes, all remaining thrusters were reset and operational. The vessel management team commenced a failure investigation thereafter.

At the time of the event, the vessel was being operated on automatic DP2 mode with 3 of 8 generators and 4 of 8 thrusters online. The main 11kV switchboards were being operated with closed bus tie, each side of the main switchboard powering one forward and one aft thruster as per the proven redundancy concept.

The investigation revealed that, as a result of an incorrect maintenance action, the initiating event was caused by a human factor – an offline generator was accidently connected to one of the main switchboards which resulted in an instant severe power instability, causing a significant active and reactive power demand and subsequent voltage and frequency drop. The generator in question then tripped on its reverse power protection resulting in significant voltage spike as a result of removing the large inductive load from the network.

The large voltage and frequency drop caused the thrusters to phase back. It is not clear from the investigation whether this was a function of the power management system or the fast acting blackout prevention function of the thruster drive (or a combination of both). The subsequent voltage spike caused by the removal of the stopped generator led to the online thrusters tripping offline. Although the investigation did not detail the reason for this, it is assumed that the thruster drives were protecting themselves from internal damage by tripping offline. Most modern thruster drives have sophisticated monitoring and protection systems measuring internal DC voltage and ensuring that this voltage does not increase or decrease beyond limits that would otherwise result in internal component damage.

The lessons:

1. The investigation report highlighted a number of findings and subsequent actions as follows:
    a) Undertake a full review of maintenance procedures on high voltage circuit breakers to ensure that this work is undertaken at suitable windows of opportunity and not during DP operations;
    b) Undertake refresher crew training and review switchboards for any need for additional safety or warning labelling;
    c) Engage with the voltage regulator and thruster drive vendors to ensure their products reacted as would be expected in such an event;
    d) Investigate the ‘locking off’ of the manual close buttons of ‘key’ HV circuit breakers including the permit to work system;
    e) Share lessons learned internally within the vessel owner’s fleet and externally within industry.
2. The investigation report did not consider bus tie position and the overall redundancy concept of the vessel. There are well documented arguments for open or closed bus tie position; however, this event clearly demonstrates the risk of a failure on one redundant group affecting the other redundant group through the common point of the bus tie. It is not inconceivable to assume that had environmental conditions been greater, necessitating more thrusters online at the point of failure, then this failure may have resulted in insufficient

thrusters offline available to be selected to DP thus causing a significant delay manually resetting thrusters and a significant drift off.

3. Continuing with the theme of closed bus operations, the investigation report did not discuss the DP FMEA specifically considering the suitability of the overall protection scheme coupled with the power management system and thruster blackout prevention functions, such that a fault cannot be transferred from one redundant group to another.
4. The investigation report detailed the desire to 'lock off' manual controls on the switchboard. Careful consideration of such an action is needed to ensure that emergency functionality is not inhibited. For example, manual circuit breaker controls may be required for emergency synchronisation of generators.

This case study demonstrates the risks of undertaking maintenance of critical DP components or systems while undertaking DP operations. The case study also highlights the challenges that exist for vessels operating in closed bus mode, i.e., where the otherwise redundant groups are connected via a common point and the risks presented as a result.

Such factors should be considered at the design stage of DP vessels and fully analysed within the vessel's DP FMEA, confirming through FMEA proving trials and subsequent DP Annual Trials Programmes.

DP Emergency Drill Scenario

DP emergency drill scenarios are included to assist crew members conduct DP drills on-board. 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. This will improve the crew competence to handle such events and assist to improve processes and procedures.

EXERCISE SCENARIO LOSS OF REDUNDANT GROUP (E.G. PORT SW/BD)
Objective: To observe the reaction of the crew and verify vessel's remaining capability following loss of any one redundant group.
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 failure by tripping online generators on the applicable redundant group. 3. Observe reaction of DPO crew, DP technical personnel, the equipment,
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?
Observations During Exercise: ♦ Is the drill procedure being followed? ♦ Is the equipment 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 duration from commencement to concluding a safe outcome for the vessel? **Actual results witnessed:** 1. EXAMPLE: DP system loses redundant group thrusters. System allocates thrust so there is no loss of heading or surge control, the vessel maintains position with remaining thrusters. If vessel is set up with due regard to applicable ASOG parameters thruster and generator loads are within acceptable limits.

EXERCISE SCENARIO	**LOSS OF REDUNDANT GROUP (E.G. PORT SW/BD)**

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.