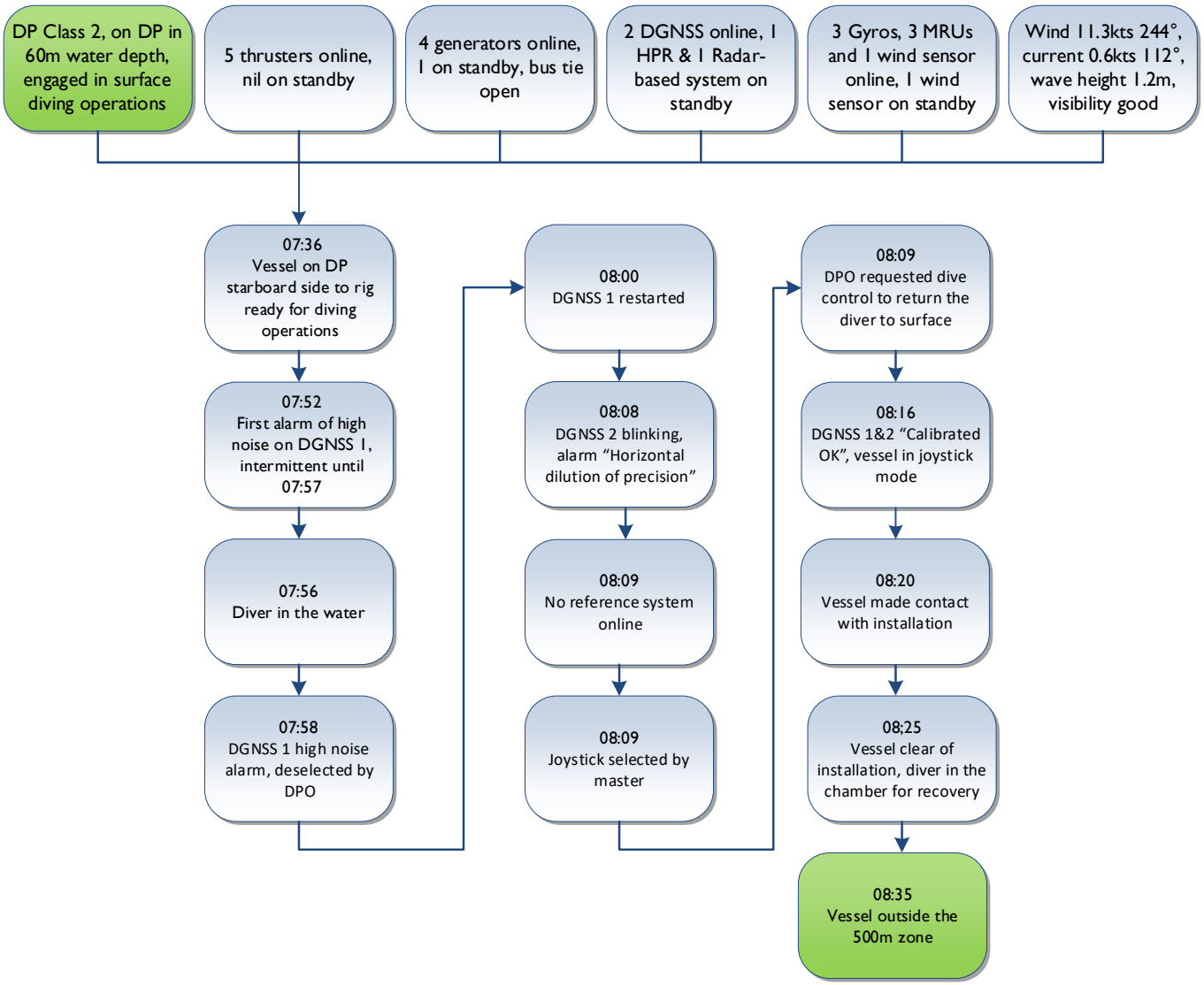
The following case studies and observations have been compiled from information received by IMCA. All vessel, client, and operational data has been removed from the narrative to ensure anonymity. Case studies are not intended as guidance on the safe conduct of operations, but rather to assist vessel 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.

1 Human Factor caused a DP Incident



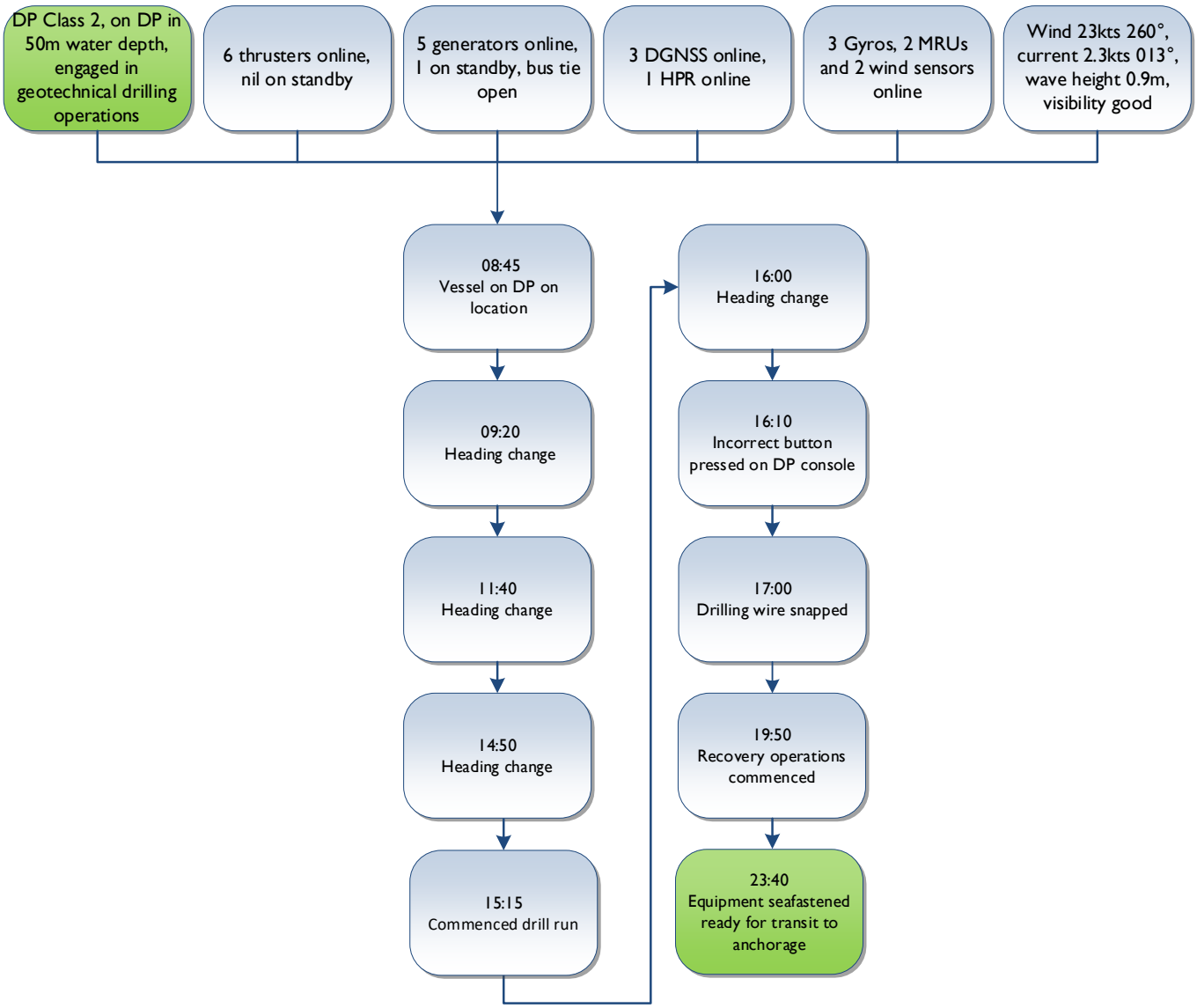
Comments from the report:

Human factor played a role here, checklists were completed but the minimum number of position reference systems (PRS) for a DP class 2 operation were not used. When both the DGNSSs failed due to high noise, other PRSs were not readily available for deployment.

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

1) The vessel was not being operated as a DP Equipment Class 2 vessel due to a lack of position reference systems in use at the time of the incident.
2) In addition to the IMCA guidance (Reference IMCA M 252 – Guidance on position reference systems and sensors for DP operations), the applicable fundamental requirements are included in IMO MSC Circular 645 & 1580 and are as follows:
    - Position reference systems should be selected with due consideration to operational requirements, both with regard to restrictions caused by the manner of deployment and expected performance in working situations.
    - For equipment classes 2 and 3, at least three independent position reference systems should be installed and simultaneously available to the DP control system during operation.
    - When two or more position reference systems are required, they should not all be of the same type, but based on different principles and suitable for the operating conditions.
3) IMCA M 220 provides guidance on Operational Activity Planning. The incident report makes no reference to the existence or implementation of decision support tools such as ASOG, in order to make sure that the DP system is functioning correctly, and that the system has been set up for the appropriate mode of operation. The use of decision support tools such as ASOG is a requirement of IMO MSC.1 Circular 1580 (section 4) which applies to all existing vessels.
4) Operational planning and the effective use of decision support tools should have ensured the correct deployment of position reference systems and identified the risk of DGNSS interference, prior to the operation.
5) This was a critical operation with high potential risks, that required robust company operating procedures including trained and experienced personnel (Reference IMCA M 117 – The Training & Experience of Key DP Personnel).
6) It is not clear from the events reported why the vessel made contact with the installation despite being in manual joystick mode for 11 minutes considering light weather conditions. In the absence of detail, it is assumed that those operating the vessel had inadequate manoeuvring competencies.

2 Human Factor caused a DP Undesired Event



Comments from the report:

The vessel was operating in shallow water and a strong current. There were several heading changes prior to the event. It was noted that heading changes, particularly in strong current should be completed at very low rates of turn. In such a situation the report commented that the vessel position should be independently monitored, such as by a survey screen, to ensure the required position setpoint remains as required.

Other actions taken:

- CAMO updated, maximum Rate of Turn (ROT) & maximum allowance for heading change amended;
- Heading change procedure generated; inc position of personnel, drillers to be evacuated from Rooster box, checks to be performed and communication protocols;
- 6 hourly checklist revised: offsets of DGNSS added & tick box added for survey position;
- Revised DP standing orders: Offset of DGNSS to be checked after rebooting OS PC. Compare survey position with DP all times during operations.

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

1) There is a lack of information available within the report however, it states that the drill string snapped 50 minutes after an “incorrect button” was pressed. It also appears that the ROT used for heading changes was too high for the operation and the offsets for the DGNSS were incorrect. Therefore, it is assumed that there was a position excursion.
2) Following the installation or relocation of position reference sensors, offsets should be permanently changed in the controllers. On at least one DP control system, position reference system offsets can be changed at the operator stations but revert to the original setting when the controllers are reset. Offsets should therefore be verified as part of operational planning.
3) Rapid heading changes in such environmental conditions may destabilise the DP model resulting in unpredictable behaviour with significant consequences. Heading and position changes should be carried out in small increments and with adequate waiting time to enable the model to stabilise between increments.
4) The use of three DGNSS is an over reliance on one PRS operating principle (DGNSS) at the expense of the other single PRS.

3 DP2 Cargo Vessel DP Incident

Case narrative

A DP2 platform supply vessel (PSV) was approaching the field and preparing for cargo operations on location. The current at the time of the event was 1.2 knots - 355 degrees and the wind force was 10 knots - 278 degrees.

During setting up to commence DP operations, the crew were unable to select the Starboard main propellor into DP control despite a number of attempts and a number of resulting alarms. Despite being unable to select the propellor to DP mode, the vessel continued to approach the platform for "urgent" cargo operations with the remaining Port propellor and two Bow thrusters (one tunnel thruster and one azimuth thruster) online.

Shortly after arrival, the Port main propellor suffered a failure resulting in a loss of DP station keeping capability. The uncontrolled movement of the vessel was almost 50 metres. The crew switched to manual mode and manoeuvred the vessel outside the 500M exclusion zone to a safe location.

At the time of the event, the vessel was being operated on automatic DP2 mode, with 2 of 4 generators and 3 of 4 thrusters online. The main switchboards were being operated with closed bus tie; the station keeping event report detailing that this was not according to "normal" operating conditions as a result of a faulty generator. The power and propulsion arrangement was such that each side of the main switchboard powered one forward and one aft thruster as per the proven redundancy concept.

The station keeping event report did not detail any investigation process or outcomes.

The Lessons

1) The decision to proceed to conduct cargo operations despite the failure of the Starboard propellor meant that the vessel was not being operated with sufficient redundancy in place (no redundancy) at the vessel's stern. Operating in this way is in contravention of all industry and regulatory guidelines from an equipment class 2 (DP 2) perspective. Industry recognised guidance on operational planning is available, reference IMCA M 220 – Guidance on operational activity planning. Also, reference: IMCA M 117 – The training and experience of key DP personnel.
2) Although the station keeping event report discusses an "urgent" cargo operation requirement, it is not known if the urgency was safety orientated or commercially orientated. Either way, this event highlights that the resultant loss of station keeping control had the potential for a far worse incident than experienced in this case.
3) It is unknown from the station keeping event report whether or not the following factors were robustly considered:
    a) Prior to arrival in field, the vessel was already in a degraded state with a generator being out of service. The report highlights that as a result the switchboard configuration was changed from open bus tie to closed bus tie. It is not known if this change in operating mode had been fully considered and if the closed bus mode was a stated mode of operation within the vessels DP failure modes and effects analysis (FMEA) and associated documentation for example DP operations manual. Reference: IMCA M 166 Guidance on failure modes and effects analysis (FMEA).
    b) There is no evidence within the station keeping event report that field arrival trials / checks were conducted. The purpose of field arrival trials / checks is to ensure satisfactory operation of the DP system and they should include full functional checks of the operation of the thrusters, power generation, auto DP and independent joystick (IJS) and manual controls. The checks also ensure that the DP system is set up correctly and that the manning is adequate. Reference: IMCA M 103 – Guidelines for The Design and Operation of Dynamically Positioned Vessels.
    c) The use of decision support tools is not mentioned within the station keeping event report. The use of decision support tools is a specific requirement of IMO MSC.1/Circ.1580 Guidelines for Vessels and Units with DP systems which requires that, before every DP operation, the DP system should be checked according to applicable vessel specific location checklist(s), and other decision support tools such as Activity Specific Operating Guidelines (ASOG), in order to make sure that the DP system is functioning correctly,

and that the system has been set up for the appropriate mode of operation. It should be noted that section 4 “Operational Requirements”, applies to all new and existing vessels and units. Reference: IMCA M 220 – Guidance on operational activity planning.

This case study demonstrates the risks of undertaking DP operations with degraded or a complete lack of redundancy. This event had the potential to have a significantly worse outcome for both the vessel and the receiving platform. The decision-making process related to proceeding to undertake the cargo operation was lacking and it is unknown if commercial or other pressures played a part of the cause.

4 DP Emergency 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 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.

EXERCISE SCENARIO	**LOSS OF SEAWATER COOLING PUMP REDUNDANCY**

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 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 Port side duty seawater pump and observe the starting of the standby pump.
3) Check that appropriate alarms are generated, and that DP equipment temperatures and functions are unaffected.
4) Repeat test however with the standby pump isolated to observe the effects on the equipment of the offline redundancy failing or being under repair.
5) Check the vessel DP crew ability to manage the situation in a controlled manner.
6) Discuss the results and determine how the risk of losing seawater cooling 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:

1) Is the DP emergency drill procedure being followed?
2) Is the equipment performing / reacting as expected?
3) Are those individuals directly involved in the exercise reacting appropriately given their assigned duties?

EXERCISE SCENARIO	LOSS OF SEAWATER COOLING PUMP REDUNDANCY

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?
8) Was the communication effective during the drill?

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's reaction and response to the failure….

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 seawater system failures in the correct manner requires knowledge of the DP specific equipment being supplied by the seawater system, how the DP system reacts to multiple failures and alarms and the human intervention required, if necessary, to ensure station keeping. Items to consider include:

EXERCISE SCENARIO	LOSS OF SEAWATER COOLING PUMP REDUNDANCY
a.	Awareness of the seawater system segregation (following the redundant groups);
b.	Appreciation of the temperature effects on DP equipment from seawater system failures;
c.	DP system reaction to multiple failures;
d.	What to look for on the operator stations;
e.	What event and alarms indicate seawater system failures (duty and standby equipment);
f.	Methods of fault finding and investigation;
g.	Appropriateness of communication;
h.	Training requirements.