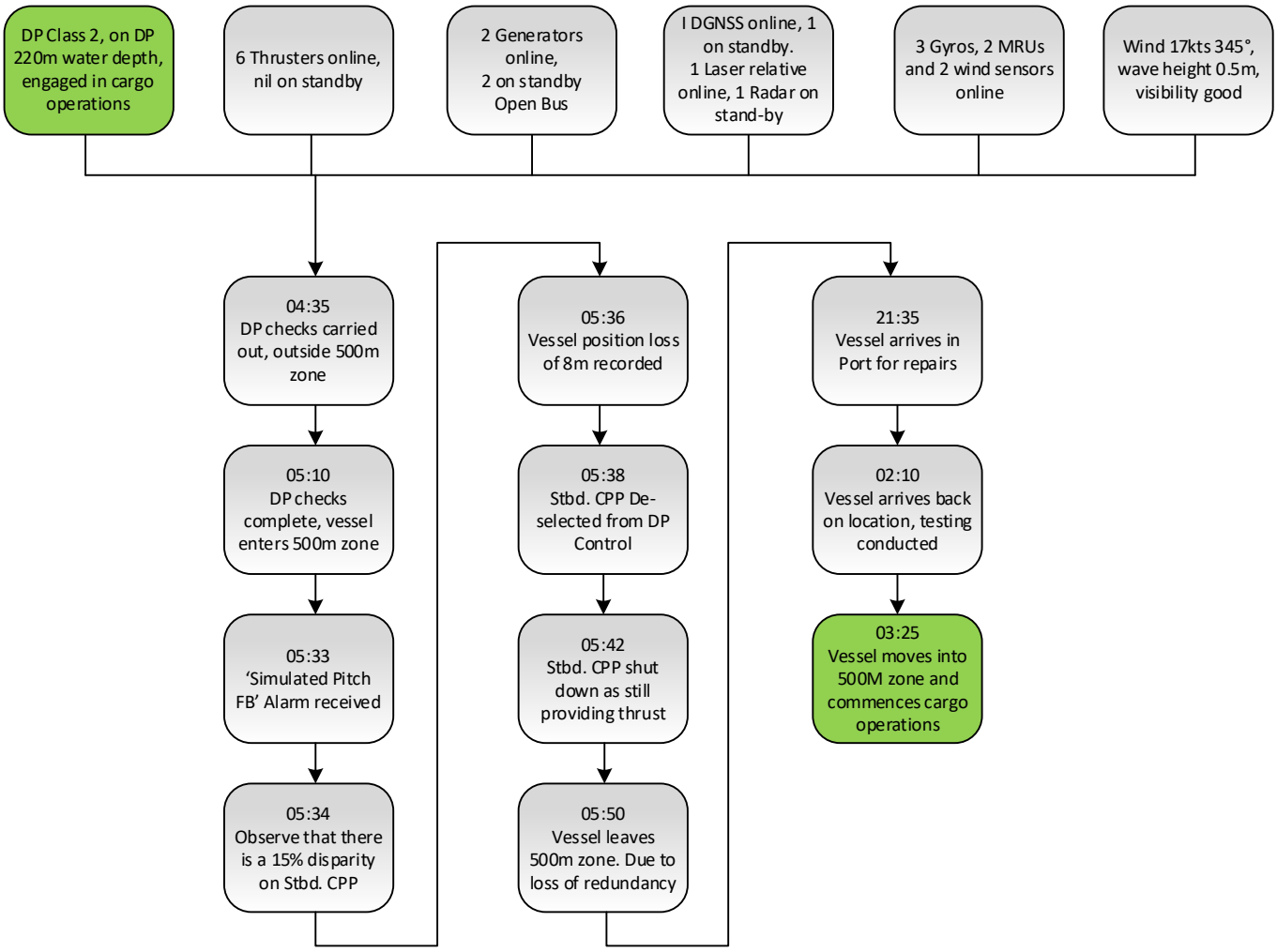
The following case studies and observations have been compiled from information received by IMCA. All vessel, client, and operational data has been removed from the narrative to ensure anonymity. Case studies are not intended as guidance on the safe conduct of operations, but rather to assist vessel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



Comments from the report:

It was found that a worn key within the coupling of the step motor (providing feedback) caused unwanted travel of the thruster pitch. The vessel was forced to return to port to source a spare part, a 'used but good' part was located and fitted.

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

1. In most direct driven CPP systems there are some failures that can lead to uncontrolled thrust and the emergency stop needs to be employed by the DPO, before the excursion becomes too significant. DPOs should not hesitate to use the emergency stop on thrusters if thruster alarms indicate a thruster control issue.

2. Use of a "second hand" part might be acceptable as a temporary stop gap measure, provided that the part is still within specification.

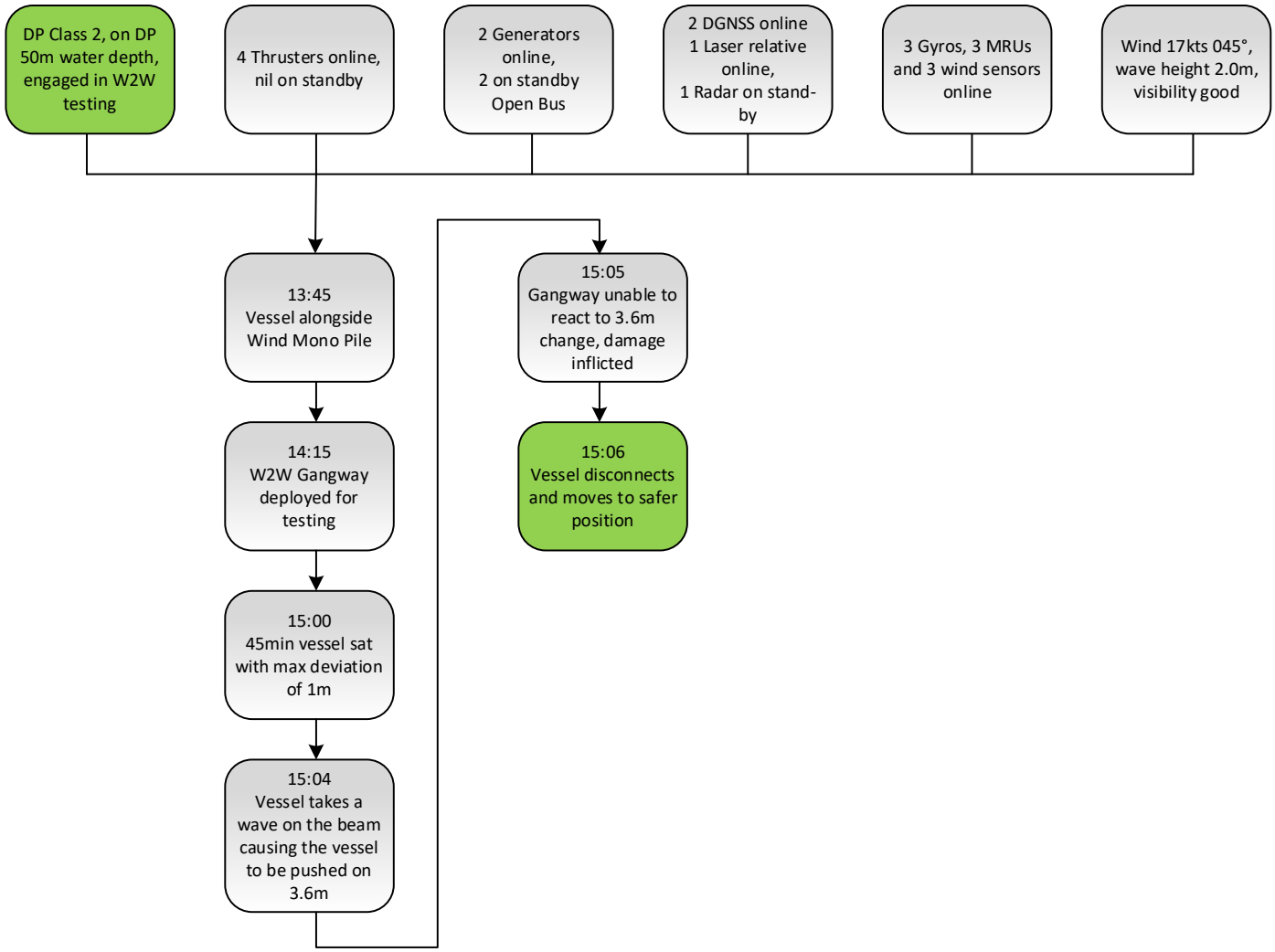
3. This event highlights the need to annually check and test controllable pitch propellers.
   M 190 Chapter 4.0 Paragraph 4.10:

   "There are many ways in which a variable speed thruster can fail, but the failure effects are generally safe. For vessels with variable speed thrusters of proven reliability, it may be acceptable to carry out the control loop wire break tests on a rolling programme where all tests are carried out over a five-year period. ***Controllable pitch propellers should be tested annually.****"*

4. Although not related to the event, the number of references is inadequate. IMO MSC Circ. 645, IMO MSC.1 Circ. 1580, and IMCA M 252, *Guidance on position reference systems and sensors for DP operations* guidance documents state that for DP 2 or 3 operations:

   "There is a requirement for 3 independent position references based on two different principles to be simultaneously available during operation."

2 Environment Causes DP Incident



Comments from the report:

The wind monopile is only equipped with a single landing point. Several DP setups were tested to define the optimal vessel heading and performance.

The capability of the DP System with the present set-up was not as expected during the W2W operation.

When the sea was on the beam of the vessel, earlier experience had shown that operating the aft azimuth thrusters in Bias was causing larger rolls of the vessel than when operating the aft azimuth thrusters in Variable mode. This applies for a significant wave height, Hs 2m and upwards, therefore variable DP control was selected.

Transfer of personnel was not permitted during the testing**.**

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

1. Larger waves and wave trains are commonly reported to be the cause of excursions/loss of position, therefore this must be considered within the planning and the ASOG. Operating with beam seas (and drift on) should be avoided when this can be expected.
2. The selection of Bias mode always requires careful consideration, Bias mode may have reduced the push off, provided the azimuth thruster athwartship was thrusting into the weather.

   IMCA M 220, *Guidance on operational activity planning*, Chapter 3 provides guidance on developing an ASOG.

3 DP2 Supply Vessel DP incident

Case narrative:
A DP2 supply vessel was sitting on stand-by outside a 500m zone of a gas platform awaiting orders for cargo operations. Whilst outside the 500m zone and on standby, the vessel closed the bustie and reduced to a single generator and three out of the five available thrusters. The vessel heading at the time was 185 degrees, the DP current was 0.8 knots - 290 degrees and the wind force was 30-40 knots - 180 degrees. Three thrusters were selected online and one of four generators were also online, the remaining three generators were ready and on standby. There was one single redundant group by virtue of a closed bustie and a single connected generator. Two DGNSS, 3 gyros, 3 VRS and 3 wind sensors were online and selected into DP Control.

Note that the vessel was upwind of the platform and in a 'Drift on' position. The area was difficult to find a safe drift off position due to location of several other platforms and sandbanks with shallow water.

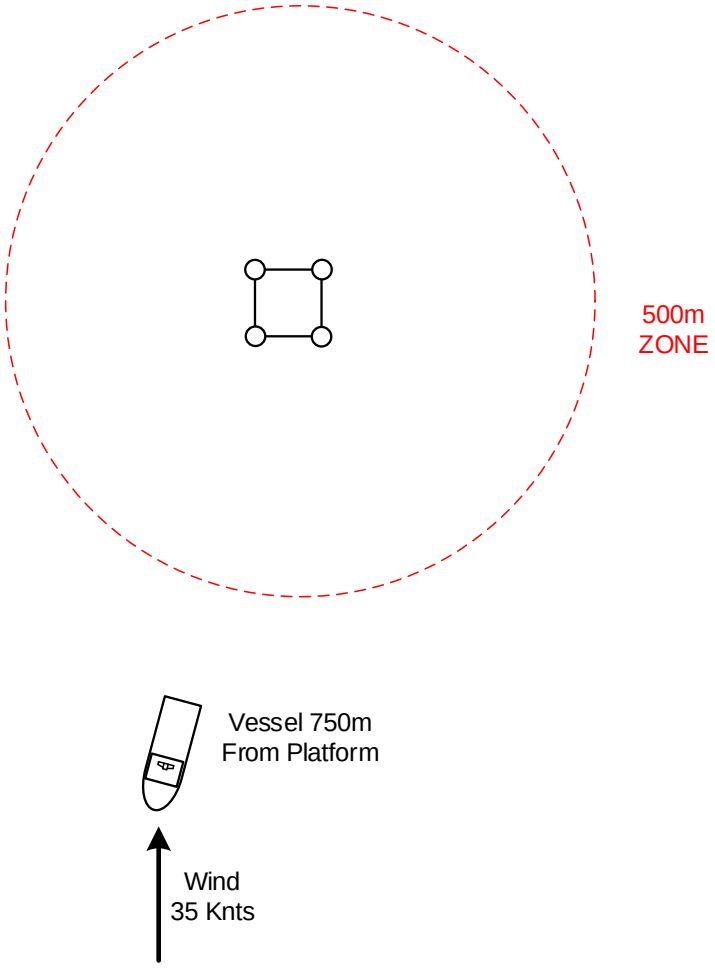


Figure 1 - Vessel on stand-by outside 500m Zone

Whilst carrying out 'daily checks' on the running engine the engineers accidently activated the emergency stop, this resulted in an immediate blackout. The vessel started to drift towards the 500m Zone and it was observed that the wind speed was increasing. As shown in Fig 2 below.

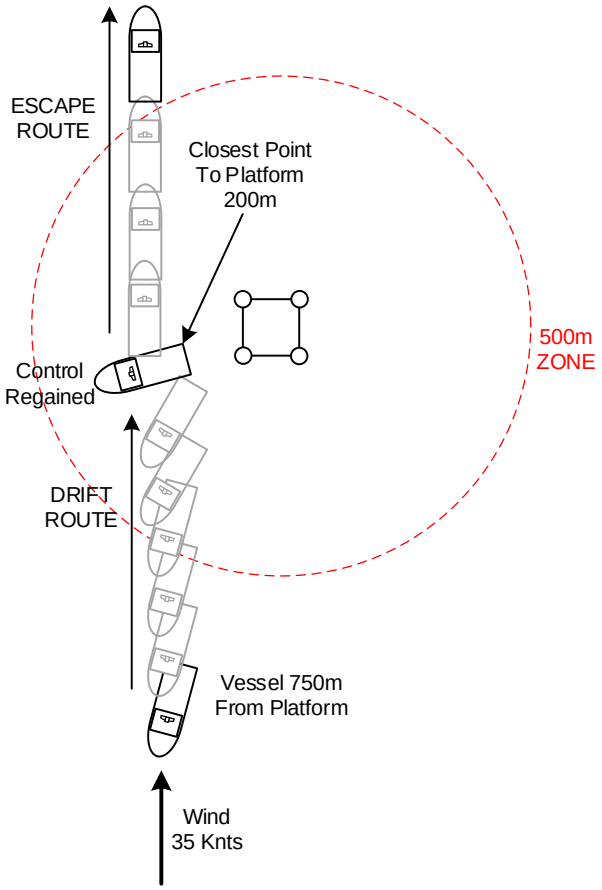


Figure 2 - Direction of Drift

As the vessel started to drift, the standby generators started and connected, however blackout recovery was a manual process that required re-setting of breakers and starting of critical machinery. As a precautionary measure an anchor was deployed that held the vessel until full manoeuvring control of the vessel could be gained. The anchor held the vessel 200m from the platform and once thrusters were back in control the vessel exited the 500m zone.

Causal Factors:
Below is a list of causes that together led to the incident highlighted above:

- The vessel was configured in such a way that a single failure would exceed the Worst Case Failure Design Intent of the Vessel Task Appropriate Mode (TAM).
- It was assumed that because the vessel was outside the 500M zone situational awareness could be relaxed and TAM could be applied.
- A protection cover for the local emergency stop on the running connected generator was missing allowing for the inadvertent activation of the emergency stop.

The Lessons
The following lessons can be taken from this incident:

1. Just because the work inside the 500m zone had stopped and the vessel could move to a 'safe' position outside the 500m zone does not mean that situational awareness can necessarily be relaxed. It was reported that in that location there were several other rigs, shallow water and sand banks. This would typically necessitate adhering to the ASOG as far as reasonably possible or adding to the ASOG. IMCA M 220 *Guidance on operational activity planning*, Chapter 3 discusses CAM and TAM where TAM is described as:

"A TAM is a risk-based operating mode in which the DP vessel may be set up and operated accepting that a failure has the potential to exceed the vessel's identified worst-case failure. Because of the variances of operational tasks and locations a vessel may have several task appropriate modes. A TAM may be applied where a thorough risk assessment has demonstrated that the consequences of exceeding the vessel's identified worst-case failure are acceptable" **In this instance exceeding the vessels WCFDI was not acceptable**.

2. The missing E-Stop Cover – The absence of the E-Stop protection should have been addressed, the purpose of the cover was to prevent such an action inadvertently. This action could have happened at any time whether or not the vessel was engaged in DP operational activities. This was not a malicious action, defects such as these need to be reported as soon as seen and rectified at the earliest opportunity. Experience has shown that an inexpensive plastic cover may save you many hours of anguish.
3. The ability of the vessel crew to respond to a blackout situation is crucial, live drills and touch drills along with regular discussions/workshops to familiarise the vessel staff on how to recover the vessel after such failure are essential. IMCA M 117 *The Training & Experience of Key DP Personnel*, gives guidance and expectations of the roles of Vessel Key DP personnel. IMCA regularly publishes examples for DP exercises and drills. These can be found at: https://www.imca-int.com/dp-events/
4. Contingency – The vessel staff acted in deploying the anchor which did have the effect of holding the vessel from the platform, but it was unknown if there were any subsea structures that could have been damaged due to this action.
5. Working/Checking on a single connected generator should be avoided to reduce the likely hood of inadvertent shut-down.
6. The IMCA/NI CPD Learning app has an extensive learning module for IMCA M 220 Guidance on operational activity planning. Further details can be found at: https://www.imca-int.com/certification/dp-operator-cpd/
7. While the deployment of the anchor reduced the vessel's uncontrolled movement, the report did not discuss the consideration of underwater infrastructure for example, cables, structures and pipelines. It is therefore not clear if the vessel staff were aware or whether this detail was included in an ASOG.

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 RECOVERY FROM FULL BLACKOUT

Objective:

To familiarise all vessel crew with what actions are required in order to recover the vessel into a controllable condition.

Method:

This test does not have to be a live test unless a safe manageable situation presents itself. A workshop should be conducted onboard.

1. Discuss what would be the first reaction upon blackout
   - How was the blackout triggered? This may change how the recovery is conducted.
   - What operations are being conducted?
   - Will personnel be directly at risk?
   - Are there still full communications?
   - Can operations be terminated?
2. Recovery – ECR - Restore Power
   - Is there a flow chart in the ECR that can be followed?
   - Will generators auto start and connect?
   - What machinery is locked out?
   - How are Generators and thrusters re-set – are there any auxiliaries that require re-setting as part of start permissive?
3. Recovery - Bridge – Secure Vessel Position & Minimise Excursion
   - Where is the vessel drifting?
   - What coms remain live most important ECR-Bridge?
   - Is there a flow chart on the Bridge that can be followed?
   - What is required in order to start the thrusters?
   - Are thrusters automatically selected into DP Control or manually?
   - Is there a clear escape route?
4. Mission Personnel – Prevent Uncontrolled Damage to Personnel, Environment and assets
   - Considerations as to how the mission personnel react to secure their equipment and communicate with Bridge.
   - How does the mission equipment react upon power up (Clamps/brakes etc.)

Observations During Workshop:

1. Is the DP emergency drill procedure being followed?
2. Are those individuals directly involved in the exercise reacting appropriately given their assigned duties?
3. Are those individuals indirectly involved reacting in an appropriate manner?
4. Is the degree of participation and diligence as expected?

EXERCISE SCENARIO	RECOVERY FROM FULL BLACKOUT

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 power system failures in the correct manner requires knowledge of the DP specific critical equipment required for vessel control, 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:

- Awareness of the power system segregation (following the redundant groups)
- DP system reaction to multiple failures
- Mission equipment reaction to power loss and power up
- Appropriateness of communication
- Training requirements

5 News in Brief

Did you know? If you are employed by an IMCA member company then you can individually register on the website using your company domain email address and have direct access to the members area including all guidance and publications, so, if you have a Bridge, ECR or Rank email onboard your vessels then the vessel staff can have that direct access.

Nautical Institute (NI) and IMCA CPD App

The NI and IMCA Continuous Professional Development (CPD) app seeks to address the 'Human' element during DP Station Keeping incidents by drawing attention to the support tools as set out in IMCA M 220 Operational Activity Planning. As can be seen in case study 3 above, understanding of CAM & TAM, along with when and where it is applied, would have prevented such an occurrence from happening.

The CPD app is available to all and is relevant to all vessel Key DP Personnel, which includes the vessels technical staff. Module 2 will be available from September 2021 which looks at PRS use, DP Documentation, Capability Plots, FMEA & FMEA Proving Trials and DP Station Keeping Events. The App is available from the NI Alexis Platform: https://www.nialexisplatform.org/certification/dynamic-positioning/dynamic-positioning-operators-cpd-app/

Station Keeping Events STATS:

The information below is a snapshot of the DP Station Keeping events to date for 2021, IMCA has a new DP reporting form that you might want to consider for your vessels, it is available on the IMCA web site (or here) and the reports can be forwarded to dpreports@imca-int.com

How many in 2021

- Total 84 Reported to date

What type

- 10 Observation
- 44 Undesired Event
- 30 Incident

Bus Configuration

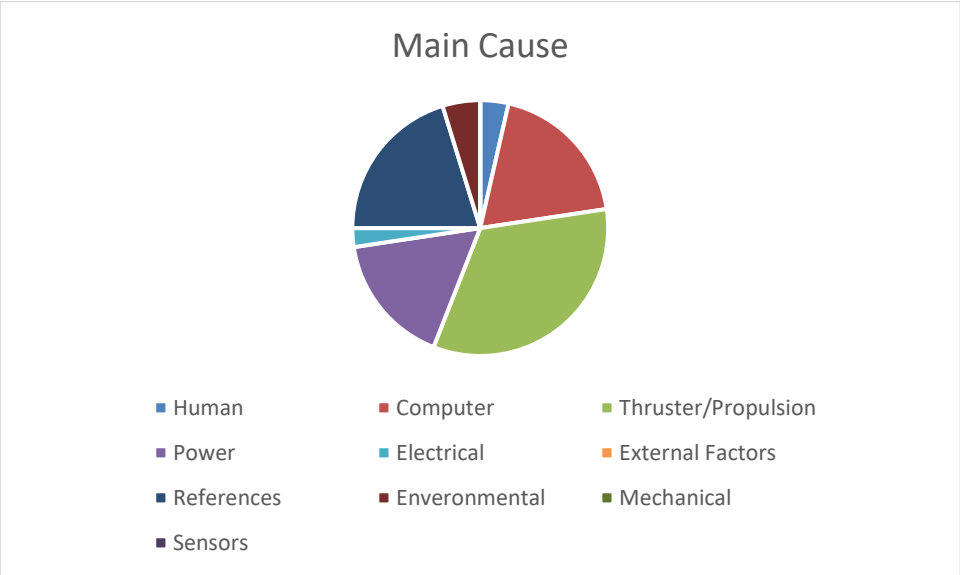
- 69 Open
- 15 Closed

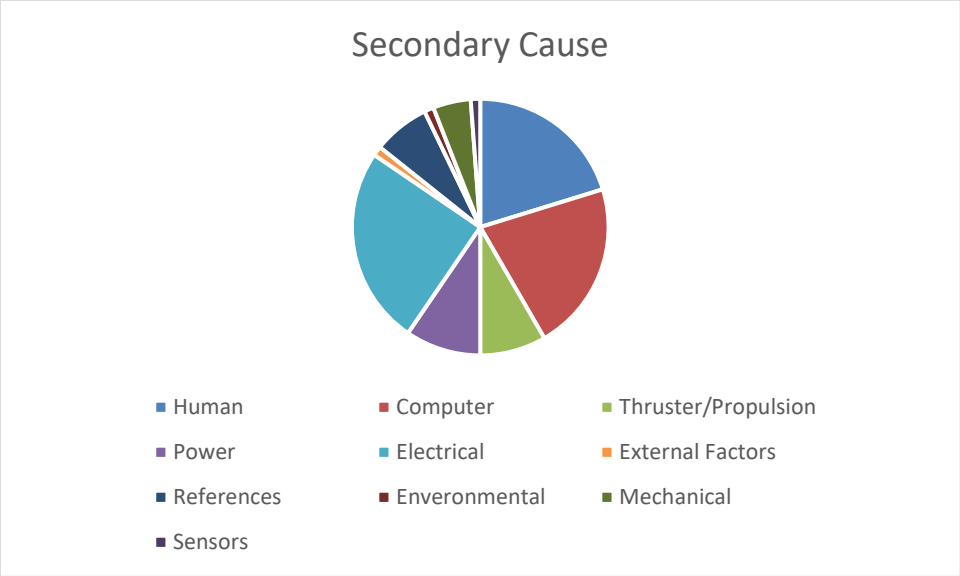
Main Cause

- 3 Human
- 28 Thruster/Propulsion
- 17 Position References
- 14 Power
- 2 Electrical
- 4 Environmental
- 0 Sensors
- 16 Computer
- 0 Mechanical

Secondary Cause

- 17 Human
- 7 Thruster/Propulsion
- 6 Position References
- 8 Power
- 21 Electrical
- 1 Environmental
- 1 Sensors
- 18 Computer
- 4 Mechanical


Main Cause
Human
Computer
Thruster/Propulsion
Power
Electrical
External Factors
References
Enveronmental
Mechanical
Sensors


Secondary Cause
Human
Computer
Thruster/Propulsion
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