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DP Emergency Drills

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Abstract

During dynamic positioning operations, a loss of position incident is a threat to safe operations and protection of the environment. DP incidents can be caused by DP system failures, human errors, improper procedures or improper design. Loss of position incidents can have as consequence loss of time, human injury, loss of life, damage to property, damage to the environment and loss of reputation. This paper intends to highlight the importance of DP emergency procedures and on board continuous training by a structured programme of DP drills in order to improve the preparedness of the DP key personnel to respond to DP failures and emergencies providing safer operations.

Introduction

Project vessels and drilling units can be 75% or more of their operational time on DP. Many of the key operations and critical tasks of DP vessels/installations are carried while on DP.

Abandon, fire, collision, flooding, grounding, man over board are common identified shipboard emergencies. These emergency scenarios are normally provided with safety management procedures and included in a programme of routine drills.

A loss of position incident is a threat to safe operations and the environment. A loss of position can lead to loss of life, human injury, damage to the environment, damage to property, loss of reputation and lost time. Industry published incident records confirm that even vessels and offshore installations fitted with redundant dynamic positioning systems are subject to loss of position incidents. Root causes of DP incidents can be DP system failures, human errors, improper procedures or bad design.

This paper is focused on DP Class 2 and 3 vessels but is also applicable for DP Class 1 vessels.

Objectives

DP drills have the following main objectives

- Familiarize the personnel with response to DP failures and emergencies.
- Improve the knowledge of the personnel on the vessel's DP system faults and failures.
- Promote technical discussions.

ISM Code

The ISM Code establishes that potential shipboard emergency situations should be identified, and also that procedures to respond to them and a programme of drills to prepare for emergency actions should be implemented.

DP operations started in 1961 and in 2013 there were more than 3,000 DP vessels in operation worldwide. ISM Code was introduced in 1993 and became mandatory in 1998. However, DP emergency procedures and drills or even DP operations procedures are still not included in some Safety Management Systems.

Considering a loss of position as a potential threat to safe operations and protection of the environment on a DP vessel, DP emergency procedures and drills should be part of every Company's Safety Management System that operates DP vessels/offshore installations.

Guidelines and Codes

The importance of DP drills was first documented by the industry in 2006 by the IMCA M117 – The Training and Experience of DP Key Personnel. Best practices of DP emergency drills are included in IMCA M117, Appendix 8.

IMCA M117 was recommended as a guideline in 2006 by IMO MSC.1/Circ.738, Guidelines for DP Operator Training, for the training of DP Key Personnel. IMO MSC.1/Circ.738 is also included as a DP reference in the MODU Code.

In 2010, DP drills were included in the Part B of the STCW Code, Section B-V/f: *“Consideration should be given to conducting appropriate DP drills as part of on board training and experience”*.

Recommended competence of DPOs regarding DP emergencies and failures is included in DNVGL Standard DNVGL-ST-0023, issued in 2014. Recommended competence on DP emergencies of DP Key Personnel is part of MTS DP Personnel Guidance for Professional Development (MDAT), issued in 2012.

DP Emergencies

A DP emergency is a system failure that results in an inability to maintain position or heading control (IMCA M103).

The loss of position event can be a **Drift Off** or a **Drive Off**.

DP Drift Off is a loss of position caused by a partial or total loss of thrust leading the DP vessel/installation to drift.

Drift off can be caused by a power system failure, thruster system failure, DP control system failure (DP control, reference systems or environmental sensors), fuel failure or DPO error.

DP Drive Off is a loss of position caused by an improper and undesired force applied to the DP system or a DP control system instability leading the DP vessel/installation to move on an undesirable direction (yaw, surge and/or sway).

Drive off can be caused by a thruster failure (frozen pitch/RPM and/or azimuth), a reference system failure, a common failure on two or more reference systems, a DP control system failure, DPO error and sudden changes in weather/current.

DP Emergency Procedures and Drills

The DP emergency procedures and drills can be included in the Operator’s Safety Management System or in the DP Operations Manual.

The DP emergency procedures should be in line with the vessel/installation operations and take into consideration the operational limitations of the DP vessel/installation.

The DP drills should provide realistic scenarios and be operational specific: drilling, diving, supply, etc.

Response to a DP emergency can be supported by a WSOG, ASOG or a DP Status Alert System. A DP emergency is a red status on a WSOG, ASOG or a DP Alert System.

Method

As best practice DP drills should cover not only DP emergencies (loss of position) but DP failures. **For most of the DP incidents, an adequate response to a DP failure can avoid a DP emergency.**

The drills can be carried out as table top exercises or realistic simulations. Although realistic simulations are more advantageous for the training and experience of the crew, it may not be always possible due to operational constraints.

Some types of drills are very important to be always carried out as practical exercises such as blackout recovery drills, manual ship handling, emergency escape maneuvers and transfer of control and setup on backup DP control system station.

Every DPO in charge of a DP watch should be able to perform an emergency escape maneuver. Also according to IMCA M182 the DP watchkeeper on an offshore supply vessel should be competent at least to take manual control and move away from the offshore installation.

Manual ship handling knowledge is very important as following a loss of position incident it can be necessary that the DPO manually maintain the vessel's station keeping until safe termination of the operations (recover of divers/diving bell, coflexip hose disconnection, etc.).

Blackout recovery drills are even more important on vessels not provided with automatic blackout recovery systems.

Vessels with automatic blackout recovery systems should also consider manual blackout recovery drills as the automatic blackout recovery system may fail or be unable to actuate due to a system malfunction, design problem, improper maintenance or incorrect setup.

Personnel

IMCA M117 establishes that the DP Key Personnel are the Master, Chief Officers, OIM, Chief Engineers, Marine Engineers, Electric-Electronic Maintenance Staff and DPOs.

All DP Key Personnel should participate on the DP drills. The DP key personnel should be prepared to respond to the DP failures and emergencies. On board routine training is a key element to keep the personnel fit to properly respond to a DP failure or emergency.

DP drills can be exercised individually by bridge and engine room teams, but combined drills are much more beneficial for the DP team.

Engine room staff have an important role in DP operations, as without sufficient power or thrust a DP vessel is not able to maintain position. Engine room personnel should be prepared for timely and safe recovery of failed equipment or systems.

As the response to DP failures and emergencies may also involve project personnel (drilling, diving, ROV, etc), it should be considered the participation of project supervisors or project team on joint drills involving scenarios such as emergency disconnection, abandon diving, etc.

The drill schedule should make feasible the attendance of both DP crews.

Competence

Recommended competence of personnel according to guidelines:

IMCA M117:

- Master should be competent to plan, execute and lead DP drills including blackout recovery.
- Chief Engineer should be competent to plan, execute and lead blackout recovery drills.

DNVGL Standard ST-0023 – Competence of DPOs:

- DPOs should have integration level (maximum level of cognition) on taking actions in case of DP failure or emergency, including drive off, drift off, vessel emergencies, collision, full blackout recovery and moving away the vessel to a safe position in a controlled manner.

MTS MDAT:

- Skilled competence level (maximum level of cognition) for SDPOs on DP drive off and drift off strategy, procedures and drills.
- Knowledgeable competence level (medium level of cognition) for DPOs, Maintenance personnel and Master on DP drive off and drift off strategy, procedures and drills.
- Awareness competence level (basic level of cognition) for OIMs and Client representatives on DP drive off and drift off procedures and drills.

Annual DP Trials

The DP emergency drills should not be understood as a replacement of the Annual DP Trials or vice-versa. Annual DP Trials are a useful training exercise for the vessel staff, but the main objective of the trials is to provide DP assurance on the DP system.

All relevant DP key personnel should achieve satisfactory involvement, participation and discussion of an emergency or failure scenario, thus the Annual DP Trials may not replace a DP emergency drill.

Supporting Tools and Documents

On board DP documentation should be used to support the DP drills:

- DP FMEA: reviewing and understanding the failure modes, their detection and effects.
- DP FMEA Proving Trials, Annual DP Trials and DP Mobilization Trials.
- DP Procedures and DP Operations Manual.
- CAMO, ASOG/WSOG.
- DP Incident Reports.
- DP Safety Alerts and Technical Bulletins.

Example of DP Emergency Drills Subjects

The table below describes different scenarios, subjects and concerns that can be included in the DP drills.

Scenario	Subject
Drive Off and Drift Off	<ul style="list-style-type: none"> • Safe recovery of failed equipment. • Drive off and drift off response strategy. • Disabling or stopping a failed/malfunctioning reference, sensor or thruster. • Emergency escape maneuver and manual ship handling. Escape route or sector. • Safe working location. • Safe termination of operations (time to terminate). • Preparation to squalls and heavy weather. • Communications during a DP emergency.
Drive off / Drift Off with Drilling/Project Department (Emergency Disconnection, Abandon Dive, etc)	<ul style="list-style-type: none"> • Review time to terminate operations. • Team work with project/drilling team. • Project/drilling operational limitations: riser angle, pipe tension, emergency escape strategy considering the diving bell limitations, etc.
Transfer of control and setup on backup DP control system station (DP Class 3)	<ul style="list-style-type: none"> • Transfer of control and setup from main DP to backup DP step by step. • If the backup DP is located in the ECR, Engineers should be able at least to perform the transfer of control, setup and monitoring of the DP control system until the arrival of the DPO.
Vessel emergency during DP operations (fire, flooding or collision)	<ul style="list-style-type: none"> • Effects and response to vessel emergencies while the vessel is carrying out DP operations.
Emergency Escape Maneuver and Manual Ship Handling (DP Joystick, Independent Joystick and Manual Controls)	<ul style="list-style-type: none"> • Transfer of control from DP to manual levers or independent joystick step by step. <ul style="list-style-type: none"> ○ Some thruster control systems will only transfer to manual if the lever is on zero thrust position. ○ DPO should press take control on the aft/fwd console to gain control of the thrusters on the manual levers. ○ DPO should change to joystick mode and select thrusters on the independent joystick to gain control of the thrusters. • Practical manual control of the vessel (DP joystick, manual levers or independent joystick). <ul style="list-style-type: none"> ○ Manual ship handling for station keeping during safe termination of the operation. ○ Emergency escape maneuver, with attention to the yaw control, while in DP or independent joystick. • Evaluation of the primary option to carry out the emergency escape maneuver: manual levers, independent joystick or DP Joystick/Auto DP (if available). <ul style="list-style-type: none"> ○ It may not be feasible or the best option due to the quantity of thrusters, ergonomic position of the levers, or the ship handling experience of the DPOs to carry out the emergency escape maneuver with the manual levers.

Scenario	Subject
Blackout Recovery	<ul style="list-style-type: none"> • Test automatic blackout recovery functionality. • Exercise manual blackout recovery actions. • Review of blackout instructions. • Emergency generator start failure.
Worst Case Failure	<ul style="list-style-type: none"> • Compare design worst case failure with capability plots. • Vessel operational limitation to maintain the redundancy following the worst case failure. • Safe termination of operations (time to terminate).
DP Control System Failure	<ul style="list-style-type: none"> • Review DP control system failure modes on the FMEA: loss of references, sensors and DP control equipment, disagreement and instability of references and sensors, etc. Effects, detection and response to failures. • Safe recovery of failed equipment. • Common failures on reference systems, etc.
Power System Failure	<ul style="list-style-type: none"> • Review power system failure modes on the FMEA: loss of switchboards, generators, auxiliaries, automation, etc. Effects, detection and response to failures. • Safe recovery of failed equipment. • Safe start of equipment on alternative switchboard, etc.
Thruster System Failure	<ul style="list-style-type: none"> • Review thruster system failure modes on the FMEA: loss of thrusters, command/feedback errors, etc. Effects, detection and response to failures. • Safe recovery of failed equipment. • Safe start of thruster on alternative switchboard.

Example of DP Emergency Drills Annual Schedule

The table below establishes an annual drill schedule for DP emergencies and failures scenarios.

Scenario		Crew	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
DP EMERGENCY	Drive Off and Drift Off	A	●											
		B		●										
	Drive off / Drift Off with Drilling/Project Department (Emergency Disconnection, Abandon Dive, etc)	A			●									
		B				●								
	Vessel emergency during DP operations (fire, flooding or collision)	A					●							
		B						●						
Transfer of control and setup on backup DP control system station (DP Class 3)	A								●					
	B									●				
Emergency Escape Maneuver and Manual Ship Handling (DP Joystick, Independent Joystick and Manual Levers)	A										●			
	B											●		
DP FAILURES	Blackout Recovery	A											●	
		B												●
	Worst Case Failure	A		●										
		B			●									
	DP Control System Failure	A				●								
		B					●							
Power System Failure	A									●				
	B										●			
Thruster System Failure	A											●		
	B												●	

Conclusion

On board continuous training is a key factor to improve and maintain DP key personnel competency. DP Drills are also a great opportunity for knowledge sharing between DP key personnel.

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