Guidance on
Operational Activity Planning

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1 Aim

The aim of this guidance on operational activity planning is to provide a brief overview of tabulated methods that are increasingly being used in the planning and execution of offshore marine vessel projects and routine offshore support activities. They apply to all sectors of the offshore marine sector, including offshore drilling, project and construction vessels and offshore supply vessels. Although usually applied to dynamically positioned (DP) vessels, the processes described in this guidance can be used for non-DP vessels[1]. Operational activity planning comprises three processes: critical activity mode (CAMO), task appropriate mode (TAM) and activity specific operating guidelines (ASOG).

Operational activity planning addresses the following:

- defines the vessel's systems/equipment configuration appropriate to the location and the activity the vessel is undertaking (CAMO or TAM);
- defines the variable limits in equipment and operational parameters for the location and specific activity (ASOG);
- defines the actions to be taken by the DP operator (DPO) in response to faults and deteriorating conditions and performance identified in the CAMO, TAM and ASOG; and
- presents the guidance to the DPO in a user friendly tabular format.

In addition the approach produces a brief document which provides a cross reference for vessel personnel (e.g. DPO, driller, dive superintendent, bridge, etc.).

1 Where these processes are applied to drilling units, both DP and non-DP, they are generally referred to collectively as well specific operating guidelines (WSOG)

2 Acronyms

ASOG	Activity specific operating guidelines
CAMO	Critical activity mode
DA	Diesel alternator
DP	Dynamic positioning
DPO	Dynamic positioning operator
EDS	Emergency disconnect sequence
ER	Engine room
ESD	Emergency shutdown
FMEA	Failure modes and effects analysis
FW	Fresh water
MODU	Mobile offshore drilling unit
MRU	Motion reference unit
OIM	Offshore installation manager
OSV	Offshore support vessel
PMS	Power management system
SIMOPS	Simultaneous operations
SW	Sea water
TAM	Task appropriate mode
UPS	Uninterruptible power supply
VMS	Vessel management system
VRU	Vertical reference unit
WCF	Worst case failure

3 Definitions

3.1 Critical Activity Mode (CAMO)

The CAMO sets out the most fault tolerant configuration for the DP system and associated plant and equipment. The CAMO should be implemented for all critical activities undertaken by the vessel. For DP Class 2 and 3 vessels the CAMO usually defines the most robust fault tolerant configuration of the DP system ensuring that a single point failure[2] does not exceed the vessel's identified worst case failure. The CAMO may be replaced by a TAM, where it is considered acceptable to operate with the vessel's DP system and equipment configured to a lesser standard of fault tolerance.

3.2 Task Appropriate Mode (TAM)

A TAM is a risk-based operating mode in which the DP vessel may be set up and operated, accepting that a single point failure could result in exceeding the vessel's identified worst case failure. A TAM is usually applied to less critical activities where a risk assessment determines that the consequences of exceeding the vessel's identified worst case failure are acceptable.

3.3 Activity Specific Operating Guidelines (ASOG)

An ASOG sets out the operational, environmental and equipment performance limits for the location and the specific activity the vessel is undertaking. The performance limits are set according to the level of risk. Where the risks are high, the limits are at their tightest. The limits may be relaxed where the risks are low. A DP vessel may have a number of different ASOGs, each applying to different locations and activities and different levels of risk.

3.4 Operational Activity Planning

The above three processes should be undertaken by all those involved with the vessel's position keeping operations. It is essential for the Master, chief engineer and DPOs of the vessel to be involved in developing the ASOG and for the vessel to take ownership of it. In the case of a MODU or, for example, a pipelay vessel or crane vessel, it will also be important to involve the driller/OIM/ superintendent.

When developing the CAMO and the TAM it is necessary to refer to the information contained in the DP FMEA so as to identify the most robust fault tolerant configuration of the DP system, in particular in the case of diesel electric vessels, the electrical power generation and distribution set up. Where the DP FMEA does not provide sufficient detail, it may be necessary to obtain the necessary information from system drawings or from an inspection of the vessel.

When developing the ASOG, it is necessary to refer to information of the location and the activity and, if available, from project plans, procedures and drawings. This information is especially important for project/construction vessels since it will be used to identify the different phases and different risk levels throughout the project.

All parties with an interest in the vessel's operational activity planning should agree on the contents of the CAMO/TAM and ASOG. There is a signature section at the end of the combined document (Table 4). The suggested signatories in that section are for guidance only and may be altered according to company requirements.

The final operational activity planning table should be displayed at the DP control console and in the engine control room. It should be clearly visible to the DPOs and engine room watchkeepers and used by them in setting up the vessel for DP operations as well as providing them with a range of responses to degraded conditions.

2 For DP Class 3 vessels a single point failure includes the loss of a single compartment through fire or flood. The term 'single compartment' is used in its widest sense and includes large compartments for thrusters/switchboards/engine rooms, etc. It may also include small enclosures containing data and control lines, etc.

4 Applicable Reference Documents

The following reference documents should be considered during the development of the CAMO/TAM and ASOG:

- IMCA M 103 – *Guidelines for the design and operation of dynamically positioned vessels*;
- IMCA 113 IMO – *Guidelines for vessels with dynamic positioning systems (MSC Circular 645)*;
- IMO MSC Circular 768 – *Guidelines for dynamic positioning system (DP) operator training*;
- IMCA M 117 – *The training and experience of key DP personnel*;
- IMCA M 166 – *Guidance on failure modes and effects analyses (FMEAs)*;
- IMCA M 178 – *FMEA management guide*;
- IMCA M 182 – *International guidelines for the safe operation of dynamically positioned offshore supply vessels*;
- IMCA M 190 – *Guidance for developing and conducting annual DP trials programmes for DP vessels*;
- IMCA M 191 – *Guidelines for annual DP trials for DP mobile offshore drilling units*;
- IMCA M04/04 – *IMCA study on 'Methods of establishing the safety and reliability of DP systems'*;
- MTS DP Operations Guidance Parts 1 and 2[3]: Appendix 1 – DP MODUs; Appendix 2 – DP Project/ Construction Vessels; Appendix 3 – DP Logistics Vessels.

3 The MTS DP Operations Guidance gives detailed guidance on the CAMO/TAM and ASOG processes.

5 Descriptions

5.1 Tabular Format – Column Definitions

The guidance in the CAMO, TAM and ASOG is presented in a tabular format in four categories, as follows:

5.1.1 Green DP Status

Green indicates **normal operations**. The DP status is **green** as long as the vessel and the DPO are able to maintain vessel position with adequate redundancy in all critical systems, and have the ability to handle expected environmental variations.

5.1.2 Advisory DP Status

Advisory indicates all operations or situations where the vessel **has no immediate risk** of losing location, but something has occurred that requires a re-evaluation of the risk. The **advisory** status should immediately start a risk assessment process. The vessel cannot remain in **advisory** status without the DPO taking action. After a comprehensive risk assessment, operations may continue with mitigating measures or the **advisory** status will be raised to **yellow**. The outcome of the risk assessment process could also mean returning to **green**. There are no conditions where **advisory** status should be considered or treated as a normal situation. If the DP system is fitted with consequence analysis this may trigger an **advisory** status.

An example of the **advisory** DP status is a failure of one of the main engine starting air compressors. This failure would not normally create a risk to activities that do not consume supplied air but the vessel should postpone any activity that would use a lot of air until the back-up compressor is repaired.

5.1.3 Yellow DP Status

Yellow indicates that **there is a high risk** of the vessel losing position **should another failure occur**. The vessel is still maintaining position although some DP critical equipment will have lost its redundancy. When in a **yellow** DP status, any operations the vessel is undertaking should be stopped so that contingency procedures are initiated such as getting ready to disconnect, diver to return back to the bell and/or moving to a safe location. If the DP system is fitted with consequence analysis this may trigger **yellow** status.

An example of **yellow** DP status would be the loss or failure of one bow thruster where the vessel is only fitted with two. In this example redundancy has been lost. The vessel would still be able to maintain position but would lose position if the remaining bow thruster failed.

5.1.4 Red DP Status

Red indicates a **severely degraded status or emergency**. A **red** status should immediately initiate a disconnection, dive bell recovery situation and all DP dependent operations terminated as the vessel is losing position. When **red** DP status is initiated it is essential to inform all relevant personnel immediately.

An example of a **red** DP status would be a fire in a DP critical compartment or space.

5.2 Critical Activity Mode (CAMO)

It is recognised that a DP vessel may often be operated in several different operational configurations. Any DP vessel can have its redundancy concept compromised if its systems are not configured or operated in the correct way. The CAMO defines the most robust configuration of the DP system. The development and the implementation of the CAMO is vessel specific.

The CAMO identifies the equipment configuration and methods of operation that ensure the vessel meets its maximum level of redundancy, functionality and operation and that no single failure will exceed the identified worst case failure (WCF). Typical items contained in the CAMO include the following:

- Power plant set up, including whether operating open or closed bus ties;
- Diesel generators, including confirmation of 100% output in DP;
- Thrusters including confirmation of 100% output in DP;
- Power management, including configuration with confirmation that auto stop is off and black out recovery start is enabled;
- Uninterruptible power supplies (UPS), including confirmation of power supply, functional testing, no cross connections;
- Manual controls and independent joystick, including confirmation of readiness and testing;
- DP control system, including consequence analysis, mode availability and selection;
- Position reference systems, including availability, testing and selection, absolute and relative systems, placement of targets for DP offshore support vessels (OSVs);
- Set speed of vessel rotation and speed of moves; for example 10° per minute and 0.3 m/sec, respectively;
- Sensors, including availability, testing and selection;
- Fuel systems, including confirmation of redundancy, tank levels, stand-by pump starts, isolations and crossovers;
- Sea water cooling, including confirmation of redundancy, stand-by pump starts, isolations and crossovers;
- Fresh water cooling, confirmation of redundancy, stand-by pump starts, isolations and crossovers;
- Compressed air/control air, confirmation of redundancy, safest compressor operating mode;
- DP and ER manning, including watchkeeping schedules, qualifications and competency of watchkeepers;
- Trials and checklist completions;
- Emergency shutdown (ESD) status (if applicable).

CAMO Table Outline: A CAMO table typically uses only two columns; **green** (normal) and **blue** (advisory). The same two-column table can be used for a TAM although the **green** (normal) conditions will differ from the CAMO.

Critical Activity Mode of Operation – Outline		
	Green	**Blue**
Definition	Normal operations – all systems and equipment fully operational, DP verification processes completed and DP set up confirmed.	Advisory status – where any of the **green** conditions are not met.
Response	For DP operations to commence and continue the conditions in the **green** column must be met.	Conduct risk assessment to determine whether to continue, change position or cease operations.

Table 1 – Critical mode of operation – outline

Table 3 on page 10 illustrates an example CAMO table.

5.3 Task Appropriate Mode (TAM)

This mode of operation is risk based in that it covers the mode that a DP vessel may be set up and operated in, accepting that a single failure **could** result in the worst case failure (WCF) being exceeded which may result in a blackout and/or loss of position. It may be appropriate in certain situations, following a detailed risk assessment, that the consequences of a loss of position are considered to be low enough to permit operating with a level of redundancy that is lower than is achieved in CAMO.

Whenever TAM is used, there should be no danger to personnel, structures or the environment by the vessel's loss of position.

Examples of TAM are as follows:

Example 1: A DP MODU may operate in TAM during occasions where the time to terminate operations is short but in CAMO where the time to terminate is long.

Example 2: A DP construction vessel may operate in TAM when more than 500m from a surface or mission critical subsea asset but in CAMO when inside 500m.

5.4 Activity Specific Operating Guidelines (ASOG)

The ASOG should define the operational, environmental and equipment performance limits for the DP vessel with respect to the specific activity that the DP vessel is undertaking and should be developed for each activity and location.

In order to develop appropriate ASOG, the following need to be appreciated:

- the technical suitability of the vessel for the specific activity;
- the identification of the vessel's CAMO;
- an understanding of the vessel's station keeping capabilities following the worst case failure.

The vessel's operational personnel and the shore based personnel, i.e. company operations, technical department should be trained in risk identification and risk assessment procedures and should play a key role in the development of the ASOG. The completed document should be signed by the vessel's Master/OIM, chief engineer, senior watchkeeping officers and DPOs and reviewed by the company operations and technical department. The sign-off requirements will depend on each company's management structure.

The ASOG may be modified in the field, subject to the strict consent of the Master/OIM, and should follow the company's management of change procedure.

A typical ASOG for a DP project/construction vessel will cover the following items:

- maximum watch circle radius (if applicable) for maximum weather conditions identified for that activity;
- maximum environmental operating conditions, including wind speed limits, current limits and wave height;
- weather specific vessel positioning performance, including position and heading excursions;
- maximum offsets permissible from the set point position;
- drive off, drift off scenarios;
- diesel generators, including the minimum number required for the activity, performance limits and failures;
- diesel generator loading;
- thrusters, including the minimum number required for the activity, performance limits and failures;
- thruster loading;
- batteries;
- power management system (PMS) and vessel management system (VMS) status of operation;

- auxiliary systems performance limits and failures, including fuel, SW and FW cooling and compressed air;
- UPS operation, charger output, supply status and failures;
- DP control system, including operation and performance of DP controllers and failures;
- DP control system displays, including mimics, performance and failures;
- DP networks, including operation, redundancy and failures;
- position reference systems, including number of enabled systems, performance and criticality to operation and failures;
- sensors, including number of enabled systems, performance and criticality to operation and failures;
- communications, including onboard systems, performance and failures;
- non essential DP related systems, including ventilation and air conditioning performance and failures;
- fire, flood, visibility, collision, including threat to the DP operation;
- simultaneous operations, including communications with assets – see IMCA M 203 – *Guidance on simultaneous operations* (SIMOPS).

ASOG Table Outline: An ASOG table uses all four columns; **green** (normal), **blue** (advisory), **yellow** (degraded) and **red** (emergency).

Activity Specific Operating Guidelines – Outline				
	Green	**Blue**	**Yellow**	**Red**
Definition	Normal operations – all systems fully functional and operating within acceptable performance limits.	Advisory status – approaching performance limits or reportable alarm status. Operations may continue whilst risks are being assessed. A failure has occurred that does not affect DP redundancy.	Reduced status – pre-defined performance limits reached, component or system failure resulting in loss of redundancy. The vessel maintains position although the vessel has lost its redundancy.	Emergency status – pre-defined operational or performance limits exceeded, component or system failure resulting in loss of control or position.
Response	For DP operations to commence and continue the conditions in the **green** column must be met.	Conduct risk assessment to determine whether to continue, change position or cease operations.	Stop operations and initiate contingency procedures with a view to reducing the time to terminate. Prepare to disconnect. The operation should not be resumed before the vessel has regained redundancy or before all risks have been fully assessed to determine whether it is acceptable to resume operations with compromised redundancy.	Abandon operations. Take immediate action, i.e. initiate emergency disconnect sequence (EDS) to ensure the safety of people, the environment, the operation and the vessel. The vessel should be moved to a safe position. No DP operation is to be recommenced until a full investigation has been implemented, failure resolved and fully tested.

Table 2 – Activity specific operating guidelines – outline

Table 4 on page 13 illustrates an example ASOG table.

6 Example of a CAMO Table

Note: This example of the CAMO is for illustrative purposes only and should be used only as a guide on how the vessel specific CAMO may be structured.

Condition	**Green**	**Advisory**
Notify Master, chief engineer and all other senior project critical personnel	No	Yes
Action	**Continue normal operations**	**Informative/consultative status (risk assess)**
Switchboard configuration	All bus ties open	Any other configuration
SG1, SG2, DA1 and DA2 (testing)	Tested at 100% on field arrival or within last 6 months	Not tested to 100% within 6 months or problems present
SG1, SG2, DA1 and DA2 configuration	SG1 and SG2 online DA1 and DA2 stand-by	Any other configuration or problems present
Emergency generator	Auto-start selected and available for use. Auto start/connect tested prior to arrival on field	Any other configuration or know problems that reduce redundancy
Blackout drill (single fuel system)	Blackout drill conducted for all DPOs and engineers. Procedures in place	Any DPOs or engineers not performed blackout drill within the last 6 months
DP power supply	All UPS functional and load tested for 30 mins 24 hours prior to field arrival. Note: Batteries to be at optimum charge before entering 500m zone	Any other configuration or known problems that reduce redundancy. Not tested for 30 mins prior to field arrival
24 Vdc power systems (load test)	All fully functional with crossover breakers DC10 and DC20 open. 30 min battery tests performed and at optimum charge before entering 500m zone	Any other configuration or known problems that reduce redundancy. Not tested for 30 mins prior to field arrival
Main engines(drive)	Operational and tested to 100% prior to field arrival	Engines not capable of 100% output or problems present
Propellers and rudders (Configuration)	One pump running on each with stand-by pumps ready	Any other setup or loss of any rudder
Bow thrusters 1 and 2	Thrusters tested to 100% in both directions on manual and DP at field arrival	Thrusters not capable of 100% command or problems present
Stern thrusters 1 and 2	Thrusters tested to 100% in both directions on manual and DP at field arrival	Thrusters not capable of 100% command or problems present
Thruster/main propellers/rudder manual levers	Tested and fully operational on field arrival	Any known deficiencies or not tested at field arrival.
Independent joystick	Tested and fully operational on field arrival	Any known deficiencies or not tested at field arrival
Manual control	Within 24 hours the Master and each DPO practise holding the vessel on position for 10 mins	Not completed
Emergency stops	Stops tested from the bridge on field arrival	Stops not tested or problems present
Thrusters, main propellers and rudders	All on line and selected into DP system	Any known deficiencies, problems or issues
DP control system	Consequence analysis enabled, no alarms active	Any other setup
DP related maintenance	Not being carried out	Requested by permit to work
DP position reference system	Median check setup and enabled, with three independent position references online	Less than three references online, position reference deviation >3m

DGPS	Both units operational and available DGPS 1 and 2 on different differential systems and elevation masks (e.g. 7° and 10°)	Any other setup
DGPS line of sight	Field of operation is clear of possible obstructions	Possibility of masking by cranes/structures
CyScan	Operational Prisms in use with appropriate gate settings to avoid spurious signals	Not operational or faulty Other reflectors in use or unable to attain gate settings
RadaScan	Operational X-band radar off, i.e. if there is insufficient vertical separation or metallic shielding from RadaScan sensor	Not operational or faulty X-band radar on with no separation
RadaScan sensor	Operational Sensor mounted on outside edge of fixed structure within vertical limits (≤2m below or ≤5m above RadaScan unit on vessel). Battery charge confirmed sufficient for duration of operation	Not operational or faulty. Sensor mounted out of vertical limits or located within installation structure. Battery charge not confirmed for duration of operation
Wind sensors	Both available	Any other setup
Gyros	All three units operational. Alignment <1 deg	Any other setup
Gyros	Manual input of speed and latitude	Auto input of speed and latitude
VRUs	Both VRUs online, no alarms, alignment <1 deg	Any other setup
Radar and traffic	Both radar on and 100% operational, no traffic conflicting with planned operations	Any other situation
Weather forecast	Reviewed and found within DP capability and DP footprint plots	Any other conditions
Position and heading alarms	Tested ok; heading warning/alarm set at 3° and 5°; position warning set at 3 and 5 m	Any other condition
Escape route (in degrees true)	Escape route identified and agreed with field operations	Escape route blocked or that possibility during planned operation
Speed of moves inside 500m zone	From 500m to 200m, <=0.5m/sec. From 200m to work site ,=0.3m/sec	Any other setting
Ventilation	All fans running in ER and thruster spaces	Any problems found
Air conditioning	Adequate cooling of DP computer area on bridge and switchboard room	Any known deficiencies
Watertight doors	All closed	Any open
Engine room manning	ER manned	ER not manned
Bow thruster room	Checked every watch for machinery function, flooding	Not checked
Fuels systems	Supply and return crossovers closed. Both port and starboard supplies and returns open. Day tanks sludged every watch	Any other setup or level alarm for day tanks. Any sign of fuel contamination, blockage or supply failure
Compressed air systems	Both compressors fully functional, auto start function tested and receivers full	Any other setup
FW cooling system	All FW cooling systems operational. Stand-by pumps tested prior to arrival on site	Any other configuration or know problems reducing redundancy
Sea water cooling system	All systems 100% operational. Stand-by pumps tested prior to arrival on site	Sea water temperature alarm

Table 3 – Critical activity mode of operation – example

7 Example of ASOG Table

Note: This example of the ASOG is for illustrative purposes only and should be used only as a guide on how the vessel project specific ASOG may be structured.

Activity Specific Operating Guidelines for the DSV xxxxx on Project xxxx *This setup **only** applies when the vessel is carrying out DP diving operations on the xxxxx project.*				
Condition	**Green**	**Advisory**	**Yellow**	**Red**
Notify Master, chief engineer and all other senior project critical personnel	No	Yes	Yes	Yes
Action	**Continue normal operations**	**Informative/consultative status (risk assess)**	**Stop operations and initiate contingency plan (be ready to move off)**	**Stop operations Disconnect/bell recovery/DP reliant operation to stop**
Current and predicted weather conditions	Within operating limits	Approaching operating limits	Exceeding operating limits	
Checklists: 6hr; watch; 500m zone	Completed	Not completed or abnormalities noted		
DRIVE OFF	All systems operating correctly	Difference in vessel position between visual, navigation and DP	Immediately when recognised by the DPO	Unable to bring vessel under control
DRIFT OFF	All systems operating correctly	Difference in vessel position between visual, navigation and DP	Immediately when recognised by the DPO	Unable to bring vessel under control
Vessel footprint/ weather related excursion	No position alarms or warning	If warning position limits reach (>3m)	If alarm position reached (>5m)	
Heading loss	No heading alarms or warning	If heading warning limit reached (>3°)	If heading alarm limit reached (>5°)	
Heading and position control (thruster load/DP feedback limits)	Heading and position control achieved with <45%	Approaching 50%	More than 50%	
Shaft generators SG1-2	SG1 and SG2 online, DA1 and DA2 stand-by. No alarms	Any other setup or alarms	Any generator failure	
Shaft generator loading	SG1 and SG2<45%	Any SG approaching 50%	Either >50% or failure of a generator	
DP UPSs	No UPS in bypass, no alarms	Any UPS in bypass or alarm	Loss of one DP UPS	
24 Vdc system	All 24 Vdc active and fully charged. No alarms	Any alarms	Loss of 24 Vdc system or charger failure	
Main propulsion (engines and rudders)	Both enabled, no alarms	Any other setup, any alarms or poor control	Loss or either port or starboard engine or rudder	

Bow thrusters available	Both enabled, no alarms	Any other setup, any alarms or poor control	Loss of any bow thruster	
Stern thrusters available	Both enabled, no alarms	Any other setup, any alarms or poor control	Loss of any stern thruster	
Fuel systems	No alarms	Any sign or potential threat of fuel oil contamination, supply line blockage, or any other supply failure	Loss of any generator due to fuel oil contamination, line blockage, or any other supply failure	
DP control system (power system mimics)	All displays check and up to date	Any incorrect information	Incorrect information that affects DP operation	
DP control system (controllers operator station)	All controllers and operator stations online	Any alarms or poor performance	Loss of one controller or operator station	
DP network	Both networks available, no alarms	Any alarms or poor performance	Loss of one network	Complete loss of networks
Position references	All fully operational and verified. No conflicts between relative and absolute reference systems.	Any alarms or poor performance	Only one remaining	
Heading sensors (gyros)	All three gyros enabled	Gyro alarms, loss of one gyro	Failure of two gyros	
Wind sensors	Both available	Mismatch alarm or loss of either wind sensor	Both wind sensors failed	
VRUs/MRUs	Both units available	Mismatch alarm or loss of one unit	Loss of two units	
Communications (ECR/deck/platform/dive control)	Redundant communications	One system remaining	No communications	
Ventilation and air conditioning	All operating as required	Any reduced ventilation or air conditioning	Reduced ventilation or air conditioning resulting in power reduction/ equipment temperature alarms	
Starting air	No alarms	Any alarm		
Fire	No fire or active alarms	Any fire alarm	Fire confirmed	Fire in DP critical compartment or space
Flood	No bilge alarms active, no flooding	Multiple bilge alarms	Flood confirmed	Flooding in DP critical compartment
Visibility	Daylight with good visibility	Any other condition		
Collision	No collision imminent/minimum approach >500m	Minimum approach will be <500m	Potential for collision	Collision imminent

This document is to be strictly followed for the named operation.

DPO Name	Signature(s)
Master Name	Signature
Engineer Name	Signature(s)
Chief Engineer Name	Signature
Client	Signature(s)

Table 4 – Activity specific operating guidelines – example