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QUALITY ASSURANCE SESSION

INTRODUCTION TO MAPPING DELIVERY ABILITY TOOL (MDAT)

A Decision Support Tool aiding development of DP Vessel Operational Teams

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INTRODUCTION: MAPPING DELIVERY ABILITY TOOL (MDAT)- A DECISION SUPPORT TOOL AIDING DEVELOPMENT OF DP VESSEL OPERATIONAL TEAMS

Delivery of incident free DP operations is achieved by addressing the three elements

- Design
- Operations
- People

The MTS DP Committee has recognized the above and it is embodied in its Mission Statement. Guidance documents have been published by the MTS DP Committee that address the Design and Operations Element. . These documents draw attention to specific requirements of station keeping as it pertains to the Industrial Mission.

The People element has traditionally been associated with the training and competency requirements. A DPO Certification Scheme managed by the Nautical Institute has been in effect for a number of years. Given the feedback from Industry on the positive impacts of the MTS Guidance documents on Design and Operations an initiative was embarked upon to address the People element in a similar vein ie with a focus on the Industrial Mission. The objective was to augment existing certification requirements with a systematic process that leveraged the MTS DP Guidance documents decision support tools eg (Well Specific Operating Guidelines /Activity /Specific Operating Guidelines) to enable the Professional Development of Personnel engaged in DP Operations.

A team was constituted and tasked with the above objective. The efforts of this team has resulted in a document that now bears the name " Guidance for Professional Development of Personnel engaged in DP Operations using the Mapping Delivery Ability Tool (MDAT) and has been published as such by the MTS DP Committee . It is available for a free download from the MTS DP Committee website.

The document covers not only the DPO's and Master but also other key stakeholders such as Maintenance Personnel and Personnel responsible for executing the Industrial Mission.

A pilot program was executed to validate the implement ability of this tool. The implementation methodology is also covered in the document.

Concurrence was sought and received from the MTS DP Committee to publish the document in its entirety in this paper.

MARINE TECHNOLOGY SOCIETY

GUIDANCE FOR PROFESSIONAL DEVELOPMENT OF PERSONNEL ENGAGED IN DP OPERATIONS USING THE MAPPING DELIVERY ABILITY TOOL

(MDAT)

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ABBREVIATIONS

AGP	ADVANCED GENERATOR PROTECTION
ASOG	ACTIVITY SPECIFIC OPERATIONAL GUIDELINES
AVR	AUTOMATIC VOLTAGE REGULATOR
BOP	BLOW OUT PREVENTER
CP	CONTROLLABLE PITCH
CPP	CONTROLLABLE PITCH PROPELLER
DGPS	DIFFERENTIAL GLOBAL POSITIONING SYSTEM
DP	DYNAMIC POSITIONING
DPO	DYNAMIC POSITIONING OPERATOR
DPS	DYNAMIC POSITIONING SYSTEM
DSV	DIVING SUPPORT VESSEL
ECR	ENGINE CONTROL ROOM
EDS	EMERGENCY DISCONNECT SYSTEM
ESD	EMERGENCY SHUTDOWN SYSTEM
F & G	FIRE & GAS
FMEA	FAILURE MODES AND EFFECTS ANALYSIS
FMECA	FAILURE MODE EFFECT AND CRITICALITY ANALYSES
HDOP	HORIZONTAL DILUTION OF POSITION
HIL	HARDWARE IN LOOP
HMI	HUMAN MACHINE INTERFACE
HSE	HEALTH, SAFETY AND ENVIRONMENT
HVAC	HEATING VENTILATION AIR CONDITIONING
IAN	INERTIAL AIDED NAVIGATION
IFO	INCIDENT FREE OPERATIONS
IRM	INSPECTION REPAIR AND MAINTENANCE
MDAT	MAPPING DELIVERY ABILITY TOOL
MOC	MANAGEMENT OF CHANGE
MODU	MOBILE OFFSHORE DRILLING UNIT
MRU	MOTION REFERENCE UNIT
OIM	OFFSHORE INSTALLATION MANAGER
OSV	OFFSHORE SUPPORT VESSEL
PRS	POSITION REFERENCE SYSTEM
ROV	REMOTELY OPERATED VEHICLE
SCE	SAFETY CRITICAL ELEMENTS
SIMOPS	SIMULTANEOUS OPERATIONS
SMO	SAFEST MODE OF OPERATION
TAGOS	THRUSTER AND GENERATOR OPERATING STRATEGY
TAM	TASK APPROPRIATE MODE
TTT	TIME TO TERMINATE
UPS	UNINTERRUPTED POWER SUPPLY
VFD	VARIABLE FREQUENCY DRIVES
VRU	VERTICAL REFERENCE UNIT
WCF	WORST CASE FAILURE
WCFDI	WORST CASE FAILURE DESIGN INTENT
WSOG	WELL SPECIFIC OPERATIONAL GUIDELINES

1 INTRODUCTION

1.1 PURPOSE

1.1.1 One of the objectives of the MTS DP Technical Committee is to facilitate incident free execution of DP Operations.

1.1.2 This is achieved by addressing the following three elements:

1. Design.
2. Operations.
3. People.

1.1.3 MTS DP Technical Committee has published guidelines addressing:

- Design – (DP DESIGN PHILOSOPHY DOCUMENT) and
- Operations (DP OPERATIONS GUIDANCE).

1.1.4 This document has been provided to industry as a guidance document to address the People element. It is focused on enabling the development of DP awareness, knowledge and skills of multi-disciplinary Vessel Operational teams and by doing so facilitates delivery of incident free DP operations.

1.1.5 The purpose of this document is to:

1. Enable development of people engaged in delivering operations where station keeping is provided by Dynamic Positioning.
2. Provide a structured approach to facilitate self-learning on DP operations with a focus on the vessel's Industrial Mission.
3. Provide a path for continuing professional development training.
4. Provide an objective means for self-assessment on DP awareness, knowledge and skills.
5. Enhance understanding of interactions and dependencies between and within multidisciplinary operational teams and the potential impact on the Industrial Mission and Station Keeping.
6. Introduce the Mapping Delivery Ability Tool (MDAT) to achieve the above.
7. Provide guidance on the implementation of the MDAT to achieve the intended effectiveness.

1.1.6 This document is not meant to replace any rules, regulations or guidelines that are in existence for minimum qualifications and experience of DP operational personnel. It is expected that compliance with applicable industry or statutory requirements will be ensured.

1.1.7 The guidance provided in this document is applicable to DP MODUs, project and construction vessels and logistics vessels. It can be applied to DP vessels of any Equipment Class.

1.2 GENERAL GUIDANCE

1.2.1 This document builds upon the guidance and focus on the industrial mission provided by the MTS DP Technical Committee Guidance documents (Design and Operations). Classification Society rules do not explicitly address the specific and sometimes unique requirements of the industrial mission. As a consequence, compliance and compliance based behaviours, by themselves, with the Classification Society Rules for the DP Equipment Class notation has not proved to be effective in delivering DP incident free operations. The guidance provided in the MTS documents is intended to enhance awareness, and knowledge. This enhanced awareness and knowledge augments compliance with the Classification Society Rules and aids delivery of incident free DP operations.

1.2.2 The guidance provided in this document is intended to enable the professional development of personnel engaged in operations where Station Keeping is achieved by DP. The goals of the guidance are to:

1. Prevent loss of position.
2. Make visible the potential to be exposed to loss of redundancy while carrying out Inspection Repair and Maintenance (planned and unplanned).
3. Safely and efficiently carry out the Industrial Mission.

This is achieved by enabling a common understanding of key factors needed to deliver safe and effective DP Operations by multi-disciplinary Marine, Maintenance and Industrial personnel.

1.2.3 The document builds on the guidance provided by the MTS DP Technical Committee on Design Philosophy and on DP Operations. The uptake by Industry of the published guidance documents, reflected by the comments sent in by the end users was leveraged and used as a foundation to develop this guidance.

1.2.4 Effective implementation of the guidance is expected to benefit:

1. Vessel Operational Teams - by enhancing overall awareness, knowledge and skills.
2. Vessel Owners/Operators - by providing a structured approach to facilitate industrial mission focused training.
3. Charterers/Lease Operators - by providing transparency, and visibility to tools used to manage station keeping risk, and the ability to leverage knowledgeable personnel to safely achieve the industrial mission objectives.
4. Industry as a whole - by providing a work force that is empowered and enabled by a sound foundation of knowledge to augment the instilled spirit of compliance.

Note: It is acknowledged that a mind-set of compliance is prevalent in Industry. It is believed that compliance accompanied by a clear understanding of the whys have the potential to aid consistent delivery of incident free DP operations.

1.2.5 The graphic below is used to visualize the above point.

Figure 1-1 Development Staircase

NOTE: It is not the intention to reproduce all the information contained in the Design Philosophy and Operations Guidance documents published by the MTS DP TECHNICAL COMMITTEE in this document. It is expected that those documents will continue to be used as source documents. Extracts from source documents when used in this guidance document are meant to serve as roadmap to information contained within the guidance documents on Design and Operations.

1.3 LAYOUT OF THE DOCUMENT

1.3.1 The document has two Parts: (PART 1 and PART 2).

1.3.2 Part 1 has the following:

- Introduction.
- Background to development.
- Identification of themes.
- Overview of themes.
- Introduction to MDAT.
- Appendix (MDAT).

1.3.3 PART 2 has the following:

- Introduction to Part 2.
- Critical success factors.
- Rollout and Implementation methodology.
- Enabling effectiveness of this guidance and MDAT.

2 DEVELOPING MDAT

2.1 BACKGROUND TO DEVELOPMENT

2.1.1 Managing of station keeping operations has been identified as a focus area. This has come about from an understanding of the consequences of a loss of position and the potential ensuing process safety implications.

2.1.2 The exponential growth and expansion in the Industry has created high demand for personnel. This rapid growth has resulted in an unintended consequence - a visible dilution of skills and experience across all facets of the energy sector. The offshore sector of the energy industry has not been immune to this.

2.1.3 Industry recognized the need for effective guidance to aid delivery of incident free DP operations. MTS DP Committee identified design, operations and people as the three areas of focus to achieve this objective. Guidance has been provided on DP Operations and DP Design Philosophy. There has been wide acceptance and acknowledgement that these documents are comprehensive and provide useful and implementable guidance.

2.1.4 This acceptance of these two documents was leveraged to develop the guidance document for people.

2.1.5 The guidance document on operations focuses on effective decision support tools. The WSOG/ASOG was seen as such a decision support tool. The WSOG/ASOG encompasses elements of design (from the FMEA), operational requirements of the industrial mission and provides clear unambiguous guidance on configurations, trigger points and criteria to aid the DP operational teams by reducing subjectivity in decisions.

2.1.6 Systematic implementation of the guidance resulting in the development and use of the WSOG/ASOG has succeeded in reducing loss of position incidents. Investigation of the loss of position incidents where effective ASOGs were in place revealed that failure to follow the ASOG was the key and at times the sole contributing factor.

2.1.7 This led to the conclusion that behaviours stemming from a culture of compliance alone were suspect. It was acknowledged that awareness, knowledge and skills of DP operations accompanied by a broad understanding of the industrial mission (the whys) could augment a compliance based culture (the hows) to provide robust barriers against the causal factors leading to a loss of position.

2.1.8 The Mapping Delivery Ability Tool (MDAT) was created to provide a structured approach to enable professional development of the personnel engaged in delivering operations using DP for Station Keeping. MDAT leverages and provides a road map to the relevant sections of the MTS Guidance documents (design and operations) to enhance and augment the knowledge base of the individual.

2.1.9 The MDAT provides a “learning” staircase to enable people to be developed to deliver top quartile performance, based on a sound foundation of knowledge of DP operations and Industrial Mission requirements.

2.2 IDENTIFICATION OF THEMES

2.2.1 A structure needed to be identified and developed to enable achievement of the objectives of the MDAT.

2.2.2 Identifying specific themes to enable focus was deemed to be an effective way.

2.2.3 A systematic and proven process of brainstorming was used to develop the themes. The eleven themes that surfaced as a result are listed below:

1. PROCESS (developing of the WSOG/ASOG).
2. FMEA (FMEA and the seven principles leading to a robust DP system - Segregation, Independence, Autonomy, Fault Tolerance, Fault Resistance , Fault Ride-Through Capability, Differentiation).
3. Causal factors of incidents 1 (Environment - Vessels working outside their post failure capability).
4. Causal factors of incidents 2 (Power plant and propulsion issues).
5. Causal factors of incidents 3 (Sensors, Position References and Software).
6. Causal factors of incidents 4 (Operator Error).
7. Inspection repair and maintenance and its effects on post failure DP capability.
8. Modes and features.
9. Industrial mission specific features.
10. Miscellaneous.
11. Common Misconceptions.

2.3 OVERVIEW OF THEMES

2.3.1 This subsection provides an overview of each of the 11 themes that are addressed in this guidance and MDAT. An understanding of the themes is essential to facilitate systematic implementation of this guidance and the MDAT.

2.3.2 It is not the intention to reproduce all the information contained in the Design Philosophy and Operations Guidance documents published by the MTS DP Technical Committee in this document.

2.3.3 Visibility is provided to these documents. Understanding the guidance and systematic application of the same by the end users is expected to aid in delivery of incident free DP operations.

2.3.4 Process - (development of the WSOG/ASOG and its implementation). The WSOG/ASOG is a proven and effective decision support tool used to aid in the planning and execution of DP operations.

1. The WSOG/ASOG is applicable to Marine, Maintenance and Industrial personnel engaged in operations where DP is used as a means of station keeping. It is expected that a minimum level of awareness exists within all personnel. Higher levels of knowledge and skills may be expected from personnel with specific responsibilities.
2. The development of the WSOG/ASOG is covered in the MTS Operations guidance on Operations in section 4.8 (Activity Operational Planning).
3. The vessel's DP FMEA is a key document to enable the development of the WSOG/ASOG.
4. The WSOG/ASOG is a repository of pertinent information gathered from:
   - The multitude of manuals that are usually present on board the vessel.
   - Detailed technical review of the DP FMEA and DP FMEA Proving Trials.
   - The operational needs of the industrial mission.
   - Any specific nuances imposed by the geographical location the vessel is operating in.

5. The WSOG/ASOG presents the information in a systematic and intuitive manner by using a four traffic light system to indicate the vessel's status.
6. Transition from one status to another triggers:
    - Notifications - (lists the key personnel to be notified upon change of status).
    - Actions - Key actions triggered by a change of status.
    - BLUE- Advisory Status – triggering risk assessments.
    - YELLOW- Cessation of operations in a controlled manner in preparation for a suspension and abandonment of the activity being undertaken.
    - RED- Immediate suspension, abandonment of activity and implementation of contingency plans.
7. The WSOG/ASOG has three distinct sections:
    - Configuration Section (How the vessel is to be set up).
    - Criteria Section (Triggering events and associated criteria for each trigger to cause a change in status from a green to blue, yellow or red).
    - Simops Section (Interactions with other vessels).

2.3.5 FAILURE Modes and Effects Analysis (FMEA): - A comprehensive DP Failures Modes and Effects Analysis accompanied by the Proving trials document is the key document providing the basis of understanding of the vessel's DP system.

1. Personnel are to be aware that operational considerations and constraints, if any, on the vessel are based on the results of the FMEA.
2. FMEA is discussed in section 4.2 and 4.6 of the DP Operations Guidance documents and sections 22.5 and 22.6 of the Design Philosophy document.
3. FMEAs should analyze and provide information about the:
    - Redundancy concept.
    - Effectiveness of protective functions.
    - Stability of the system under the full range of load/operational conditions.
    - Monitoring functions.
    - Degraded and failure conditions.
4. A comprehensive FMEA in addition to being a deliverable to obtain the DP equipment Class notation should:
    - Identify system vulnerabilities not just non compliances with Class Requirements.
    - Provide a comprehensive and transparent analysis.
    - Facilitates Independent performance verification.
    - Functions as a crew training resource.
    - Identifies critical maintenance issues related to redundancy.
    - Identifies potential system configuration errors and acts of maloperation.
5. FMEA should provide clear identification of:
    - Worst Case Failure Design Intent (WCFDI).
    - Worst Case Failure (WCF) – which may be found upon analysis to differ from the WCFDI.
    - Post Failure DP Capability (focused on post failure thrust capability).

- Configurations to facilitate setting up vessel in the Critical Activity Mode (CAM) and Task Appropriate Mode (TAM).
- Vulnerabilities, if any, including those of auxiliary systems.

2.3.6 Causal factors – general: - Analysis of incidents over a 10 year period has revealed that the causal factor of incidents can be categorized into 4 main areas (reference IMCA study M181).

1. Loss of position resulting from vessels operating outside their post failure capability (Environment).
2. Loss of position initiated by triggering events associated with power and propulsion systems (Power and Propulsion).
3. Loss of position initiated by triggering events associated with sensors, position reference sensors, software and hardware.
4. Operator error.

These causal factors are addressed as themes. Overview is provided in 2.3.7, 2.3.8, 2.3.9 and 2.3.10.

2.3.7 Causal factors of incidents (environment): - Nine per cent of the incidents analyzed during the 10 year period were attributed to vessels operating outside of their post failure capability.

1. Loss of position resulted when technical failures resulted in loss of thrust. Vessel's where such Loss of position occurred had not paid heed to setting operational limits based on post failure capability.
2. Some of these loss of position events resulted during IRM and a lack of understanding of impacts on non-availability of equipment due to IRM and the potential for altering the post failure capability.
3. Thruster and Generator Operating Strategy (TAGOS) is developed and used to make visible the impact of non-availability of equipment in configurations where a multitude of permutations and combinations are feasible.
4. DP Incidents have also resulted on vessels where operational limits have been derived from capability plots without understanding that such plots are theoretical in nature. Degradation of delivered thrust due to a multitude of reasons (e.g. thruster to hull and thruster to thruster interaction, degradation due to high current conditions) have not been taken into consideration.

2.3.8 Causal factors of incidents (Power and Propulsion): - 32% of the incidents analyzed during the 10 year period were attributed to issues associated with power and propulsion systems on vessels. Such issues resulted from technical failures.

The consequence (loss of position) could have been avoided by appropriate operator intervention. Such incidents were attributed to operator error without cognizance of the initiating events/failures which were preventable. Subsequent understanding of the causal factors led to devising and implementing mitigating measures to prevent failures resulting in loss of position.

1. Principles of independence, segregation, autonomy, fault tolerance, fault resistance, fault ride through and differentiation were better understood and used to establish Critical Activity Mode (CAM) and Task Appropriate Mode (TAM) configurations.

2. Guidance on power plants (generation, distribution) and propulsion, auxiliary systems, power management systems, automatic black out recovery features is provided in the MTS Design Philosophy document in Sections 9, 10 & 11.

2.3.9 Causal factors of incidents (Position Reference Systems):- 38% of the incidents analyzed during the 10 year period were attributed to issues associated with sensors, position reference sensors, software etc.

Such issues resulted from technical failures. The consequence - (loss of position) could have been avoided by appropriate operator intervention. Such incidents were attributed to operator error without cognizance of the initiating events/failures which were preventable. Subsequent understanding of the causal factors led to devising and implementing mitigating measures to prevent failures resulting in loss of position.

1. Principles of independence, segregation, autonomy, fault tolerance, fault resistance, fault ride through and differentiation were used to establish Critical Activity Mode (CAM) and Task Appropriate mode (TAM) configurations.
2. Guidance on sensors and position reference systems is provided in the MTS Design Philosophy document in Section 14, 3/4, 15, 16 and MTS DP Operations Guidance document Section 4.4.

2.3.10 Causal factors of incidents (operator error): - 21% of the incidents analyzed during the 10 year period were attributed to either being initiated by operator or a consequence of incorrect operator response.

1. Introduction of effective guidance on development, implementation and use of the WSOG/ASOG has resulted in reducing subjectivity in the decision making process.
2. Maintaining and adhering to the integrity of the development and implementation process of the ASOG/WSOG, can result in reducing the potential for incidents due to operator error.
3. Guidance on the process of developing ASOG/WSOG is provided in sections 4.11 and 5 of the MTS Operations Guidance documents and Section 18.1 of the DP Design Philosophy document. In addition, implementing the guidance provided in this document is expected to aid in reducing errors attributed to operator error.

2.3.11 Inspection Repair and Maintenance (IRM): - Managing IRM effectively has been identified as key contributor to delivery of incident free operations.

The need has been identified to:

1. Enhance understanding of issues.
2. Ability to carry out structured documented risk assessments.
3. Establish robust PTW systems.

Guidance on managing IRM is provided in section 4.10 of the MTS DP Operations Guidance document and section 21 of the MTS DP vessel Design Philosophy document.

2.3.12 Modes and features: - The Industrial Mission dictates the modes and features the vessel needs to be equipped with. This section predominantly pertains to project and construction vessels.

1. With the migratory patterns observed within the industry between logistics vessels, project and construction vessels, and MODUs it was deemed prudent to emphasize this section.

2. Information on such modes and features are contained within section 14.7 of the DP Design Philosophy document and 4.6 of the MTS DP Operations Guidance document appendix 2&3.

2.3.13 Industrial mission specific features: - The Industrial Mission dictates the modes and features the vessel needs to be equipped with.

1. This theme predominantly pertains to MODUs.
2. With the migratory patterns observed within the industry between logistic vessels, project and construction vessels, and MODUs it was deemed prudent to emphasize this section.
3. Information on such modes and features are contained within section of 17 of the MTS DP Design Philosophy document and section 4.8 of the MTS DP Operations Guidance document.

2.3.14 Miscellaneous: - This theme is a catch all for several items that do not readily fit into any of the other themes.

It covers a broad range of topics. As an example the following are considered:

1. Establishing a drive off to drift off strategy.
2. The use of Positioning Standby.
3. The increasing influence and requirements being imposed on DP Operations by the Regulators.
4. Guidance on the above is provided in Sections 4.8 of the DP Operations Guidance document (app 1 & sect. 4.9 in app. 2&3).

2.3.15 Common misconceptions: - This theme addresses common misconceptions existing in the Industry.

1. Information on this is dispersed in the MTS DP Guidance documents on design and operations and in the TECHOP Guidance notes.
2. It is expected that this theme will be delivered using effective means of information sharing by skilled and knowledgeable personnel.

2.4 INTRODUCTION TO MDAT

2.4.1 The Mapping Delivery Ability Tool (MDAT) has been developed by the MTS DP Technical Committee as a repository for the information provided in this guidance. The structure has been devised to facilitate adapting the tool to the Industrial Mission/Classification Category of the DP vessel (MODUs, Project and Construction Vessels or Logistics).

2.4.2 A Matrix format was deemed suitable to capture the 11 themes discussed in this document and link it to the different positions and disciplines that make up the vessel operational teams engaged in carrying out operations where DP is used as a means of station keeping.

2.4.3 Three categories, Aware, Knowledgeable and Skilled are used to facilitate mapping the delivery ability of personnel. It is reiterated that the primary objective of the MDAT is to provide a structured approach to enable:

1. Development of people.
2. Self-learning and self-assessment.
3. A path to establish training with a focus on requirements of the Industrial Mission.

CAUTION: The temptation to use this tool for assessment purposes (including assessments by third parties), without systematically achieving the above three objectives should be avoided. Guidance on the roll out and application of the tool is provided in Section 3. This guidance is intended to aid in achieving the intended value of the MDAT.

2.5 MDAT DEFINITIONS

2.5.1 MDAT uses the following three terms: Aware, Knowledgeable and Skilled, they are further defined here as:

1. AWARE:- Able to explain, describe, discuss, identify, locate and report on the area of knowledge and its relevance, potential impact and consequences to the operations associated with the industrial mission.
2. KNOWLEDGEABLE: Able to demonstrate understanding of the terminology and vocabulary in the area of knowledge. Able to demonstrate understanding of the operations associated with the industrial mission and potential impact, consequences. Able to execute planned procedures. Able to plan, prioritize and adapt to evolving situations.
3. SKILLED: Able to translate guidelines and standards in the area of knowledge and its relevance to the operations associated with the industrial mission and potential impact, consequences into practical actions. Able to develop, review and modify procedures in the area of knowledge. Able to evaluate, differentiate, discriminate, validate and communicate solutions to common technical and operational problems. Provide mentorship and training in the area of knowledge, relevant to the industrial mission.

2.6 MDAT APPLICATION

2.6.1 A visual representation is provided below to aid in discussing the intended application of the MDAT.

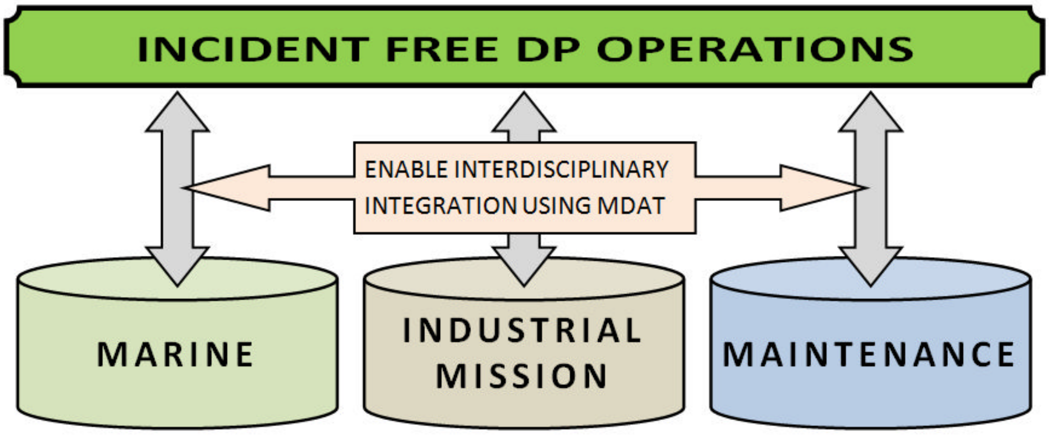

Figure 2-1 Intended Application of MDAT

2.6.2 It takes a multi-disciplinary team to deliver the objective of the Industrial Mission. On DP vessel broadly these teams fall into three distinct categories:

1. Marine.
2. Maintenance.
3. Industrial Mission Personnel.

Depending on the set up in the Contractor's organization, the maintenance discipline could be part of the Marine department or be its own discipline.

Disciplines by definition tend to create silos. This should not be seen as an impediment to deliver the top objective – incident free DP operations. It is recognized and acknowledged that it takes teams a *team effort* to achieve this objective.

The MDAT facilitates access from these silos to deliver the top objective by identifying key focus areas where a level of awareness, knowledge or specific skill sets are needed for DP operations. A common understanding of impacts on the overall objective of the Industrial mission by actions within the disciplines is expected to foster team work and enhance inter discipline communications.

2.6.3 All personnel are not expected to have multifunctional skills enabling them to cross over to the specific disciplines. Enhanced understanding of DP operations in the space depicted in the diagram named "facilitating common understanding using MDAT" is intended to be the focus area of MDAT. This focus is expected to aid in development of people by:

1. Providing a platform and structured approach to a common appreciation of impacts by actions within disciplines.
2. Enabling delivery ability of incident free DP operations.
3. Aiding Progression to supervisory roles by a deeper understanding of other disciplines.

2.6.4 The following example is used as an illustration:

1. Effects of IRM on Industrial Mission.
2. E.g. - A monohull MODU with six thrusters (3 bow thrusters and 3 stern thrusters). See Figure 2-2.
3. Configuration - Vessel WCF is loss of three thrusters.
4. Scenario - Intention is to take one of the bow thrusters out of service for routine maintenance. Thrusters are numbered 1, 2, 3, 4, 5 and 6. T1 and T2 have commonality, T3 is the thruster that is intended to be taken out of service.
5. Impacts - With T3 out of service - onset of conditions for WCF or any failure affecting T1 and T2 results in loss of all bow thrusters and loss of position.

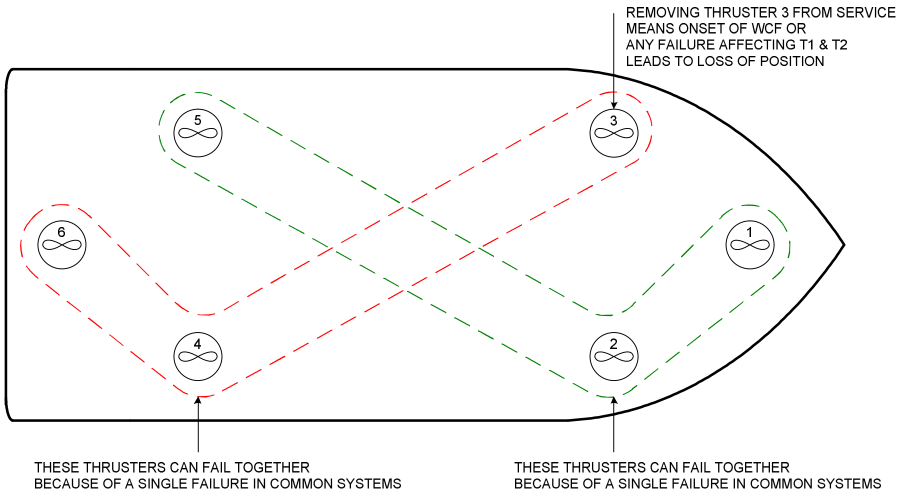

Figure 2-2 Thruster Arrangement

	Principle	Source Reference	Focus Areas	SDPO	DPO	Maint. Mech.	Maint. Elect	Master	Rig Manager	Driller	Toolpusher	Company Man
SECTION 7 IMPACTS OF IRM	Permit to work	MTS DP OPS sect. 4.10	All maintenance on DP equipment to be conducted under a PTW	S	K	S	S	K	A			A
	Impacts on capability	MTS Design sect. 21.2	Understand the need to re-assess post worst case failure capability before taking down equipment	S	K	K	K	K	A			A
	Project scheduling	MTS DP OPS sect. 4.10	IRM to take into account upcoming industrial mission activities	S	K	S	S	K	K			K
	Documented risk assessments		Impacts of unavailability of equipment (for extended periods of time) to be captured in a documented risk assessment (for both TAM and CAM)	S	K	S	S	K	K			K
	Reinstating equipment post failure or post "intrusive" maintenance	MTS DP OPS sect. 5 (app.2)	Consider a proactive yellow before reinstating equipment which is being made available	S	K	S	S	K	A		K	A

SDPO: Skill-level

SDPO is to be aware of impacts on Post Failure capability, potential impact that the vessel will not be left with any thruster in the bow if the WCF manifests itself, requirement for a PTW, engage with the Industrial mission folks to ensure that Industrial mission activity is such vessel is not required to operate in CAM, appropriate notifications, assessments of present and forecasted weather conditions.

Maintenance: Knowledgeable

Maintenance Department to be aware of impacts on post failure capability, requirement for a PTW, understanding of the industrial mission activity being performed.

Master: Knowledgeable

Master is to be aware of impacts on Post Failure capability, Weather conditions, and able to articulate the impacts to other members of the vessel management team.

Rig Manager: Aware

Aware of the potential to experience a loss of position. Activity to be planned to minimize exposure to well integrity.

Company Man: Aware

Aware of the potential to experience a loss of position. Activity to be planned to minimize exposure to well integrity.

3 PART 2

3.1 INTRODUCTION TO PART 2

3.1.1 Part 2 contains guidance on a suggested implementation methodology. The MDAT was sequentially rolled out as a pilot on three DP MODUs. Learnings from the 1st DP MODU of the pilot project were rolled into the subsequent DP MODUs, guidance contained in Part 2 is based on observations and learnings from the pilot roll out.

3.1.2 The guidance provided in this part is not intended to be followed rigidly. It is expected that end users/ stakeholders will be able to address observations and learnings described herein as deemed appropriate for their own organizations.

3.1.3 Critical success factors (Section 3.2) described, are from observations during the Pilot Project.

3.1.4 Roll out and Implementation methodology (Section 3.3) describes the roll out used in the Pilot Project.

3.1.5 Section 3.4 contains the requirements to enable the efficacy of the MDAT.

3.2 CRITICAL SUCCESS FACTORS

3.2.1 The following are the critical success factors for the MDAT to succeed:

1. Clarity and definition of Objectives.
2. Transparency.
3. Consistency.
4. Commitment and Engagement.
5. Sensitivity to Diversity.
6. MDAT rollout and delivery team Technical and Operational Skills (Not to be confused with the vessel operations delivery team).

3.2.2 Clarity and definition of objectives: There should be no ambiguity in communicating the purpose of the tool. There should be a clear understanding that this is not meant to perform an audit or an assessment of the individuals. If the intent is to use the tool for assessments this should be preceded by the suggested two phases:

1. Roll-out as a self-learning and self-assessment tool.
2. Followed by another engagement to provide guidance, coaching and mentoring as needed.

There should be sufficient time allocated between the phases to maximize the benefit of using the tool.

3.2.3 Transparency of objectives, (intent, and use of MDAT): is a must and should be provided to all stakeholders (Shore Based Management, Delivery Teams, Onboard Vessel Management, Disciplines and Individuals)

3.2.4 Consistency: The message delivered by the Delivery team should be consistent. Inconsistencies will derail the process and rapidly erode the value.

3.2.5 Commitment and Engagement: In order to realize the value that the MDAT can provide a strong sense of commitment and engagement is required of the Contractor's Management and the Delivery team. Both these parties are to be firmly engaged in the process and facilitate delivery

3.2.6 Sensitivity to Diversity: The delivery team should be trained to be sensitive to the diversity to be expected in the operational teams. The growth in the industry has led to a wide range of diversity in all aspects (e.g. prior skill, training, present skill levels, experience in industry).

3.2.7 Delivery Team Technical and Operational Skills: The delivery teams should have strong technical and operational skills and in-depth knowledge of the Industrial Mission. They should have the ability to communicate technical rationale in a simple, clear and concise manner to operational teams.

3.3 ROLL OUT AND IMPLEMENTATION METHODOLOGY

3.3.1 This section provides an overview of the roll out and implementation methodology used in the Pilot Project. The outcome was positive and is therefore suggested as a practice worth replicating. Nothing in this section is meant to dissuade adopting effective alternate methods.

3.4 PREPARATION

3.4.1 Roll out of the MDAT is to follow a structured format. The structured format is not meant to impose rigidity. The structure should provide a road map to delivery.

3.4.2 Personnel involved with the roll out are to be trained in the delivery of MDAT. Desirable traits of delivery personnel are:

1. Strong personal and people skills (e.g. ability to empathize, communicate, overcome barriers).
2. Ability to adapt, tailor and deliver a message to a diverse audience.
3. Ability to empathize with people.
4. Strong sense of commitment to aid delivery of incident free DP operations.
5. Team composition should include personnel with superior technical and operational knowledge of Dynamic Positioning with emphasis on the Industrial Mission of the subject vessel.

3.4.3 Commitment from Leadership (Shore Based and Operational Vessel Management Teams) is essential.

3.4.4 The MDAT message should be consistent to all stakeholders.

3.5 ROLL OUT (FIELD)

3.5.1 Three distinct phases are involved in the Roll-out:

1. Phase 1 - Engagement with Onboard Management.
2. Phase 2 - Engagement with Individuals.
3. Phase 3 - Wrap up.

3.6 PHASE 1 - ENGAGEMENT WITH ONBOARD MANAGEMENT

3.6.1 Duration 1.5 to 2 hours.

3.6.2 Givens - prior communication sent out to the onboard management team by the shore based management outlining purpose and objectives of the MDAT delivery team.

3.6.3 Kick off meeting with the Onboard Management Team: Suggested participants (DP MODU).

1. Master.
2. Chief Engineer/RMS.
3. OIM/Rig Manager.
4. Client Representative.

3.6.4 Follow Agenda: Agenda to include overview of risks and risk management,

3.6.5 Must wins from this engagement are:

1. Management commitment and buy in.
2. Making available individuals for one on one engagement.
3. Time for wrap up.

3.7 PHASE 2 - ENGAGEMENT WITH INDIVIDUALS

3.7.1 Time commitments - range between 1 to 2 hours per individual - SDPO up to 2 hours, Master up to 1.5 hours, others 1 to 1.5 hours.

3.7.2 Agenda development and follow up: - Agenda to include overview of Development Staircase, (ref section 1.2.3). Creating a common understanding, (ref section 2.6). Overview of MDAT. Identification of Station Keeping as Safety Critical Element and Process Safety Implications, Standards and Guidance available, objectives of MDAT.

3.7.3 The above part is to be carried out using appropriate audio visual aids and effective information sharing techniques. Ability to identify effective communication method for the individual is a key success factor. (e.g. Facts, and figures, anecdotal instances, conversational).

3.7.4 After this communication, provide broad overview of the MDAT to show how it is applied to all disciplines. Then focus on discipline relevant to individual

3.7.5 Roll out is to focus on communicating effectiveness of the tool as a self-learning self-assessment decision support tool.

3.7.6 Provide overview of the levels as described in the MDAT < Awareness, Knowledge and Skilled as it pertains to the individual.

3.7.7 Provide overview of the MTS DP Design Guidance document and MTS Operations document.

3.7.8 Must wins from this engagement are:

1. Effectively communicate ability of tool to aid self learning and development in delivery of incident free DP operations.
2. Potential for MDAT as a means to build a staircase taking you from the plateau of compliance to levels of world class knowledge and delivery capability.
3. Ability of tool to be used for self assessment.
4. Potential for MDAT to be used for structuring training programs.

3.8 PHASE 3 - WRAP UP ENGAGEMENT WITH OPERATIONS MANAGEMENT TEAM AND INDIVIDUALS FROM DISCIPLINES

3.8.1 At the minimum, representation from each discipline to be encouraged. - Primary objective is to seek feedback from the onboard personnel to identify opportunities for improvement of the MDAT and delivery. Secondary objective is to seek reinforcement of onboard vessel management commitment to support implementation of the MDAT (Time Commitment - 1 to 1.5 hours).

3.8.2 Follow agenda: - Agenda to include ability to recognize positive behaviours and make visible opportunities for improvement.

3.8.3 Seek feedback, both positive and negative with a view to enhance the MDAT.

3.8.4 Communicate actions ensuing from the visit and time line to develop and implement action plan if appropriate.

3.8.5 Must wins from the engagement are:

1. Transfer of ownership of tool to onboard personnel.
2. Management commitment to support implementation of tool based on realizing value add from the MDAT in managing station keeping risk.

3.9 ENABLING EFFECTIVENESS OF THIS GUIDANCE AND MDAT

3.9.1 This section describes four focus areas. Trigger words are used to identify the focus areas and a brief description provided on each of them:

1. Enabling.
2. Leveraging.
3. Behaviours.
4. Recognizing Challenges.

3.9.2 Enabling: The guidance in this document and the MDAT are designed to enable delivering incident free DP operations though a structured and uniform approach to learning and development. Committed implementation of the guidance facilitates the enhancement of the skill levels of diverse work force through a process of self assessment. It provides a means to identify and facilitate training needs. It enables people to make the journey from an acceptable level of compliance to the desired level of knowledge and skill to perform as a world class delivery professional.

3.9.3 Leveraging: The guidance in this document provides a road map to leverage the MTS DP Guidance documents on design and operations and apply it in the manner it was intended. It builds on the proven decision support tools like the ASOG/WSOG.

3.9.4 Behaviours: The guidance addresses the people element of the three legged stool, Design, Operations and People. The people element is best addressed by a focus on behaviours. This document fosters and enables efficient communications between disciplines stemming from a respect and common understanding of individual objectives and impacts on delivery of operations. The structure of the MDAT is designed to augment effective coaching and mentoring through self learning and self assessment. This approach is expected to deliver visible benefits by a step change in behaviour from one of compliance alone to one based on a clear understanding of reasons (the whys) and facilitate appropriate management of risks to operations where station keeping is achieved by Dynamic Positioning.

3.9.5 Recognizing Challenges: This subsection summarizes observations during execution of the Pilot Project.

3.9.6 Of the main drivers of this guidance document is to enable delivery of incident free operations by people with limited experience. This limited experience by itself introduces challenges that need to be recognized and addressed by the delivery team.

3.9.7 Engagement by the Leadership is a key success factor. Visible engagement by the leadership is to be sought through focused familiarization of this guidance and the MDAT.

3.9.8 The Delivery Team should be able to tailor the message to the audience without diluting the content or altering the consistency. The Delivery Team should have the requisite operational and technical knowledge, people skills and training to be effective. Flexibility to deliver the message may be impeded if it is made a requirement to deliver the message by rote.

3.9.9 Temptation to use the tool as a 3rd party assessment tool or an audit tool is to be avoided without following the suggested implementation methodology in this document.

APPENDICES

APPENDIX A (MDAT)

Mapping Delivery Ability Tool

SKILLED: Able to translate guidelines and standards in the area of knowledge and its relevance to the operations associated with the industrial mission and potential impact, consequences into practical actions. Able to develop, review and modify procedures in the area of knowledge. Able to evaluate, differentiate, discriminate, validate and communicate solutions to common technical and operational problems. Provide mentorship and training in the area of knowledge, relevant to the industrial mission.

KNOWLEDGEABLE: Able to demonstrate understanding of the terminology and vocabulary in the area of knowledge. Able to demonstrate understanding of the operations associated with the industrial mission and potential impact, consequences. Able to execute planned procedures. Able to plan, prioritize and adapt to evolving situations.

AWARE: Able to explain, describe, discuss, identify, locate and report on the area of knowledge and its relevance, potential impact and consequences to the operations associated with the industrial mission

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	Principle	Source reference		SDPO	DPO	Maint (Mech)	Maint (Elec)	Master	Rig Mgr / OIM / OCM	Toolpusher	Driller	Company man
SECTION 1 WSOG PROCESS	Understanding of WSOG	MTS DP OPS sect. 4.8	Inputs required- FMEA, DP manuals, industrial mission, notification	S	K	K	K	S	K	K	K	K
	WSOG notifications	MTS DP OPS appendix C	Notifications - Understand if person is aware of notification protocols stipulated in WSOG/SMS/DP Procedures/Standing orders	S	S	K	K	K	A	A	K	A
	WSOG development	MTS DP OPS sect. 4.7 section 3 / MTS DP OPS sect. 4.8	FMEA - Clear understanding that WSOG is created from a technical review of the vessel's FMEA, gaps in FMEA has been bridged, project requirements are understood, and vessel's industrial mission requirements are incorporated	S	K	K	K	K	A	A	A	A
	WSOG traffic lights	MTS DP OPS sect. 4.8 / WSOG	Actions upon Blue Yellow and Red to be clearly understood. Need for documented risk assessment with appropriate sign off to be in place if decision is made to continue to operate when in WSOG yellow condition	S	S	K	K	S	K	K	K	K
	Structure of WSOG	MTS DP OPS appendix C	CAM Configuration, criteria, and SIMOPS	S	K	K	K	K	A	A	A	A
SECTION 2 FAILURE MODE EFFECTS ANALYSIS (FMEA)	Key attributes of a robust DP System	MTS Design sect. 3.3	The seven attributes that make a robust DP system, Autonomy, Independence, segregation Fault detection, Fault Protection, Fault Ride-through and Differentiation, Ability to grasp the core concepts	S	K	S	S	K	A			A
	Identification of worst case failure (WCF)	MTS Design sect. 3.12	What is the defined WCF on the vessel; Has this been clearly identified in the FMEA? Does this match with the WSOG? If there is a difference between WSOG and FMEA?	S	K	S	S	K	A			A
	Post WCF capability	FMEA / MTS DP OPS sect 4.2 guidance notes / MTS Design sect. 3.12	Is there an understanding that the vessel's capability (thrust) is reduced after experiencing WCF? Is there an understanding that the station keeping capability after suffering WCF is reduced (lower environment)? Is there an appreciation that critical operations are limited to post WCF capability?	S	K	K	K	K	K			K
	Task appropriate mode (TAM) concepts	MTS Design sect. 4.1	When is TAM permitted? What are the allowed flexibilities (power plant config, thrusters, thruster loading, position reference sensors). Need to carry out documented risk assessments	S	K	K	K	K	A			A
	Vulnerabilities if any (eg: SW, FW, fuel)	WSOG / FMEA	Has the review surfaced any vulnerabilities that need to be managed?	K	A	S	S	K	A			A
	Critical activity mode (CAM) concepts	MTS DP OPS sect. 4.8	When is CAM required? What are the stipulations (power plant config, no. of thrusters, thruster loading, position reference sensors)	S	K	S	S	K	K			K
SECTION 3 CAPABILITIES (ENVIRONMENT)	Intact vs. post WCF capability	MTS Design sect. 3.12	Understanding of this basic concept and clear understanding of control required in surge, sway and yaw to DP	S	K	A	A	K	A			A
	Effect of WCF	MTS Design sect. 3.12.9 / 10.8.7	Awareness that after WCF, remaining thrusters and engines will have to deliver double the initial output	S	K	K	K	K	A			A
	Establishing criteria for CAM and TAM	MTS DP OPS sect. 4.8	Usually TAM - loss of one thruster, CAM - Post WCF remaining thrusters	S	K	K	K	K	K			K
	IRM impacts and identifying critical thrusters	MTS Design sect. 21.2	Assessment to be made on WCF with available thrusters. Critical thrusters (mono hull 6 thruster configurations)	S	K	K	K	K	K			K
	Thruster and generator operating strategy (TAGOS)	MTS DP OPS sect 4.7	Understanding of TAGOS (if applicable) and how it is to be used.	S	K	S	S	K	A			A
	Understanding of capability plots	MTS Design sect. 4 MTS DP OPS sect. 4.8	Awareness that capability plots are theoretical in nature. Actual capabilities may be different. Impacts of losses (thruster to thruster and thruster to hull interactions). Limitations if any on available power, degradation in thrust due to current.	S	K	A	A	K	A			A
	Foot prints and capability plots	MTS Design sect 4.2 MTS DP OPS app. A MTS DP OPS sect 4.3	Foot prints vs. capability plots, potential causes of anomalies in foot prints (position reference systems)	S	K			K	A			A
	Precautions in using online capability plots		Does not take into account thrust losses which could be variable	S	K			K	A			A
	Thruster / power limits in WSOG	Capability plots ad WCFDI	Impacts of directionality of wind and current	S	K	K	K	K	K			K
SECTION 4 POWER AND PROPULSION	TAM	MTS DP OPS Sect. 4.8	When is TAM permitted? What are the allowed flexibilities (power plant config, thrusters, thruster loading, position reference sensors). Need to carry out documented risk assessments	S	K	S	S	K	A			A
	TAM		Why is TAM even considered?	S	K	K	K	K	K			K
	TAM		What industrial missions are permitted to consider TAM?	S	K			K	K			K
	TAM		Flexibility - power plant configuration	S	K	S	S	K	A			A
	CAM	MTS DP OPS sect 4.1	When is CAM required? What are the stipulations (Power plant config, no. of thrusters, thruster loading, position reference sensors) Considerations for positioning standby.	S	K	S	S	K	K			K
	CAM	MTS Design 10.7	Why safety, automatic change-overs and protective devices are not given credit during CAM operations	S	K	S	S	K	A			A
	CAM / TAM	MTS DP Design sect. 3.9	Links with time to terminate (TTT)	S	K	A	A	K	K	K	K	K
	Open / closed bus	MTS Design 10.8.5	Common mode failures	K	A	S	S	K	A			A
	Open / closed bus	MTS DP Design sect. 3.20.1 / 10.8.6	Island concepts - Principles of segregation, autonomy, independence	K	K	S	S	K	A			A
	Open / closed bus	MTS Design sect. 9.5.1	AVR failures	K	A	S	S	K	A			A

	Open / closed bus	MTS Design sect. 9.4.2	Governor failures	K	A	S	S	K	A			A
	Open / closed bus	MTS Design sect. 9.7.12	Advanced generator protection / advanced generator supervisory systems (as examples) as means to reduce potential of consequences of common mode failures	K	A	S	S	A				A
	Open / closed bus	MTS DP OPS Sect. 4.8 (CAM-section)	Why vessels with advanced protection systems are still required to operate in CAM	K	A	K	K	K	A			A
	Open / closed bus	MTS Design sect. 22.5.4	Difficulties with testing closed bus protective devices	K	A	S	S	K	A			A
	UPS	MTS DP Design sect. 13	Principles of independence and segregation emphasized. Awareness that UPS should be treated as a power source in the FMEA.	K	A	S	S	K	A			A
	Dependence on emergency generator (if applicable)	MTS Design sect. 10.4	Robust designs should not depend on emergency generators and distribution. Conflict with class rules if any to be clearly understood and impacts while on DP to be managed through WSOG. Principles of segregation to be followed	A	A	S	S	A	A			A
	Bus instability	MTS DP Design sect. 5.11.1 / 9.3.2	Effects of transient loading	S	K	S	S	K	K	K	K	A
	Propulsion	MTS Design sect. 3.17 / 9.1.9/9.1.10	Principles of independence and segregation emphasized	S	K	S	S	K	A			A
	Propulsion	MTS Design sect. 7.18.1	Need to have all thrusters available (default especially for VFDs)	S	K	S	S	K	A			A
	Propulsion	MTS DP OPS Sect. 4.10 (guidance-section)	TAGOS (if applicable) and its use through the WSOG	S	K	S	S	K	A			A
	Propulsion	MTS Design sect. 14.17.2	Use of bias, precautions to be undertaken, under what conditions is bias released automatically	S	K	A	K	K				
	Propulsion	MTS Design sect. 3.11.1 / 9.1.10	Recognition of common mode failures and its identification / mitigation.	S	K	S	S	K				
	Propulsion	MTS Design sect. 7.13.2	On CPPs, potential to fail to full pitch and means to avoid	S	K	S	S	K				
	Auxiliaries (Fuel, FW, SW, air (start and control), lubricating systems, HVAC	MTS Design sect. 8.2.2 / 8.3.1 / 8.4.1	Principles of independence and segregation to be followed. Additionally guidance in Table 8.1 of MTS DP design document to be followed.	K	A	S	S	K	A			A
	Auxiliaries (Fuel, FW, SW, air (start and control), lubricating systems, HVAC	FMEA / WSOG	Ascertain if crossovers are fitted to facilitate maintenance and if so managed to maintain segregation. Look for opportunities for improvement by adding critical and non critical redundancy	K	A	S	S	K	A			A
	Auxiliaries (Fuel, FW, SW, air (start and control), lubricating systems, HVAC		Understanding of importance of monitoring of auxiliaries including redundant equipment	K	A	S	S	K				
	Automatic black out recovery	MTS Design sect. 11.15.3 / 11.15.7	Philosophy and testing mechanism for automatic BOR and importance of documenting times	K	A	S	S	K	A			A
	WSOG configurations		Clear understanding of how the configuration is addressed in the WSOG (CAM/TAM) and the level of detail that is required for the unit in question	S	K	S	S	K	A			A
	Power management system (PMS)		Understanding that the PMS system should be set up properly and (FMEA) tested to ensure the redundancy concept is not defeated	S	K	S	S	K	A			A
SECTION 5 HARDWARE, SENSORS, POSITION REFERENCES	Hardware (DP control)	MTS Design sect.8,9&10	Principles of independence and segregation observed. No cross connections	S	K	S	S	K	A			A
	Hardware (DP control)	WSOG / FMEA	In accordance with identified configuration for CAM	S	K	S	S	K	A			A
	Hardware (DP control)	WSOG / FMEA	UPS configuration in accordance with CAM	S	K	S	S	K	A			A
	Hardware (DP control)	MTS Design sect.3&12	Importance and dependence on networks understood and reason for red on loss of networks understood	S	K	K	S	K	A	A	K	A
	Sensors	MTS Design sect. 3 & 15	Principles of independence, segregation, diversity (to the extent feasible) understood	S	K	A	S	K	A			A
	Sensors	WSOG / FMEA	UPS configuration in accordance with CAM	S	K	K	S	K				
	Sensors		Importance of avoiding cross connections	S	K	A	S	K				
	Sensors	MTS DP OPS Sect. 4.4	Failures of sensors and how they are addressed in WSOG and why	S	K	A	S	K	A			A
	Sensors	MTS DP OPS Sect. 4.4	Vulnerabilities of vessels equipped with 2 gyros	K	A	A	K	K	A			A
	Position references (PRS)		Reference sensor set up and handling in DP control system	S	K		S	K				
	Position references (PRS)	FMEA	UPS supplies in accordance with CAM	S	K		S	K				
	GNSS	MTS Design sect. 15	Principles of independence and segregation	S	K	A	S	K				
	GNSS	IMO 645	Multiple GNSS does not mean meeting requirements of redundant position reference sensors	S	K	A	K	K	A			A
	GNSS	MTS DP OPS Sect. 4.4	Why no more than 2 GNSS systems are to be used in the solution when used in conjunction with another position reference system	S	K	A	K	K	A			A
	GNSS		Ideal configuration of GNSS systems. GPS + GLONASS; global corrections	S	K	A	K	K				
	GNSS	MTS DP OPS Sect. 4.4	Importance of elevation masks	S	K	A	K	K				
	GNSS	spaceweather.com	Errors in GNSS (solar activity)	S	K	A	K	K	A			A
	Acoustic systems	MTS DP OPS Sect. 4.4	Principles of independence and segregation	S	K	A	K	K	A			A
	Acoustic systems		Depth limitations of USBL	S	K	A	K	K	A			A
	Acoustic systems	MTS DP OPS Sect. 4.4	Need for two independent acoustic systems on drilling rigs (including 2 arrays)	S	K	A	K	K	A			A
	Acoustic systems		Potential for inference and frequency management	S	K	A	K	K	A			A
	Inertial aided navigation IAN		Introducing differentiation and orthogonality to PRS	K	A	A	K	K	A			A
	IAN GNSS	MTS DP OPS Sect. 4.4	IAN and advantages	K	A	A	K	K	A			A
	IAN acoustics		IAN acoustics and potential to use USBL in deeper water/LBL with same update rate as GNSS to avoid skewing in weighting	K	A	A	K	K	A			A
	Relative PRS		Need for redundant relative PRSes (industrial mission dependent)	K	A	A	A	K	A			A
	Laser PRS		Cyscan / Fanbeam	K	A	A	A	K	A			A
	Laser PRS		Why prisms are recommended over reflective tubes	K	K	A	K	K	A			A
	Radar PRS		Radius / Radascan	K	A	A	A	K	A			A
	Taut wire PRS	MTS DP OPS Sect. 4.4	Industrial mission; water depth limitations / dependencies	K	K	K	K	K	A			A
	Taut wire PRS		Taut wire winch not to be used as a lifting / deploying device	K	K	A	A	K	A			A
	Riser angle monitoring		ERA; ARA. Limitations and conditions for use (monitoring only)	S	K		K	K	A			A
	Other PRS		Industrial mission specific PRS (E.G. horizontal taut wire, gangway)	K	A	A	K	K	A			A
SECTION 6 OPERATOR ERROR	Failure to follow ASOG		WSOG/ASOG akin to a permit to work; personal consequences	S	K	S	S	S	K	K	S	K
			Need to follow the WSOG/ASOG	S	K	S	S	S	K	K	S	K
	Recovery from failure		Proactive yellow before reinstating failed equipment	S	K	S	S	K	A		K	A

		Maloperation		Ergonomics, inadvertent pushing of buttons / operating valves, hazard hunts, procedures	S	K	S	S	K	A	A	A	A
SECTION 7	IMPACTS OF IRM	Permit to work	MTS DP OPS sect. 4.10	All maintenance on DP equipment to be conducted under a PTW	S	K	S	S	K	A			A
		Impacts on capability	MTS Design sect. 21.2	Understand the need to re-assess post worst case failure capability before taking down equipment	S	K	K	K	K	A			A
		Project scheduling	MTS DP OPS sect. 4.10	IRM to take into account upcoming industrial mission activities	S	K	S	S	K	K			K
		Documented risk assessments		Impacts of unavailability of equipment (for extended periods of time) to be captured in a documented risk assessment (for both TAM and CAM)	S	K	S	S	K	K			K
		Recovery from lockout / tagout	MTS DP OPS sect. 5 (app.2)	Consider a proactive yellow before reinstating equipment which is being made available	S	K	S	S	K	A		K	A
SECTION 8	MODES AND FEATURES	Follow target mode	MTS Design sect. 14.7.6 /7	Precaution for use. Industrial mission and vessel dependent.	S	K	A	A	K	A			A
		Follow target mode	MTS DP OPS sect. 4.5 (app.2)	Construction vessels - redundant relative PRSes when working near floating facilities. Absolute PRSes to be in use (GNSS and usable acoustics; water depth considerations)	S	K	A	A	K	A			A
		External force compensation	MTS Design sect. 14.7.8	Riser transfer and umbilical transfer (if applicable)	S	K	A	A	K	A			A
		Heavy lift mode	MTS Design sect. 14.7.2	Industrial mission dependent when potential for instability exists. In addition to mode, robust and executable contingency plans to be in place. Effective mitigations must be in place along with detailed procedures.	S	K	A	A	K	A			A
		Pipe lay mode	MTS Design sect. 14.7.8 / 14.8.1	Industrial mission and company philosophy dependent. The use of external inputs automatically into DP control system prohibited unless accompanied by a detailed and proven systems engineering approach.	S	K	A	A	K	A			A
		External inputs	MTS Design sect. 14.8.1 / 16.1-2	The use of external inputs automatically into DP control system prohibited unless accompanied by a detailed and proven systems engineering approach.	S	K	A	A	K	A			A
SECTION 9	INDUSTRIAL MISSION SPECIFIC FEATURES	Emergency disconnect	MTS DP OPS sect. 4.8	Awareness of development of red watch circles and EDS times	S	K	A	A	K	K	K	K	K
		Emergency disconnect	MTS Design sect. 17.5	Awareness of different times if different EDS modes are available	S	K	A	A	K	K	K	K	K
		Riser analysis	MTS DP OPS sect. 4.8	Inputs from riser analysis into WSOG	K	A	A	A	K	K	A	A	K
		Riser analysis	WSOG	Environmental conditions	K	A	A	A	K	A	A	A	A
		Riser analysis	vessel specific	Running / retrieval parameters	K	A	A	A	K	S	K	K	S
		Riser analysis	vessel specific	Hang off parameters	K	A	A	A	K	S	K	K	S
		Riser analysis	MTS DP OPS sect. 4.8	Establishing credible watch circles (environment dependencies; 1 year, seasonal variations, 95% env etc)	S	A	A	A	K	K			K
		Riser analysis	MTS DP OPS sect. 4.8 (WSOG section)	Awareness that POD and EDS times are for drift off NOT drive off	S	K	A	A	K	A			A
		Riser analysis		Metocean parameters for riser analysis	K	A			K	A			A
		Emergency shut down	vessel specific	Awareness of ESD nuances on subject vessel (cause and effects matrix)	K	A	S	S	K	A		K	A
		Emergency shut down	MTS Design sect. 17.5.8	Awareness that automatic BOR does not function when black out is triggered by ESD	K	A	S	S	K	A		A	A
		Emergency shut down	MTS Design sect. 17.5.8	Procedures for recovery from ESD and drills.	K	A	S	S	K	K	K	K	K
		BOP mode (lock to bottom)	vessel specific	(If fitted) Awareness of limitations imposed on station keeping and controls in place (PTW)	S	A	K	K	K	A	A	K	A
		Water depth issues	MTS DP OPS sect. 4.4 note 13, 4.7 (wsog-section)	Effects of water depth upon industrial mission (time to terminate, position reference sensors, metocean conditions, analysis [example: riser analysis, installation analysis])	S	K	A	K	K	S	A	A	S
SECTION 10	MISCELLANEOUS	Coastal state requirements	MTS Design sect. 15.6	How are coastal state requirements made known to the crews and adherence managed	K	A	A	A	S	A			A
		Drive off to drift off strategy	4.7 (wsog-section)	Awareness of what a drive off to drift off strategy is	S	K	K	K	K				
		Drive off to drift off strategy	4.7 (wsog-section)	Detailed procedures in place	S	K	K	K	K	A			A
		Drive off to drift off strategy	4.7 (wsog-section)	Drills (frequency and effectiveness and participation)	S	K	K	K	S	A			A
		DP position standby	MTS DP OPS sect 4.8 (guidance note)	Awareness of events triggering positioning standby, potential impacts (configuration changes, manning requirements, IRM)	K	K	K	K	K	K	K	K	K
SECTION 11	COMMON MISCONCEPTIONS	Redundancy concept violations	MTS Design sect. 21.2.4	Awareness of redundant equipment to be treated as essential equipment in operation and in use and not viewed as "installed spares"	S	K	S	S	K	A			A
		Bus tie configuration	DP Design sect. 10.8.5 Incident reports	Myth: closed bus tie is safer, and vessel can operate in closed bus tie for CAM	K	A	K	K	K	A			A
		Bus tie configuration	DP Design sect. 9.7.12 Incident reports	Myth: Vessel has adequate protection to operate in closed bus tie for CAM	K	A	K	K	K	A			A
		Bus tie configuration	MTS Design sect. 9.2.4/5 & 22.5.5/6	Myth: Short circuit testing cannot be done	A	A	K	K	A				
		Bus tie configuration	MTS Design sect. 11.6.1	Myth: Station keeping system are unaffected by cross connections with industrial mission equipment	K	A	K	K	K	A			A
		Capability plots	MTS DP OPS Sect. 4.7.3 / 4.8.1	Myth: Capability plots are a true representation of the vessel's station keeping capability	K	A			K	A			A
		Class notation	IMO 645 sect 2.7 MTS design sect. 3.3.2	Myth: The vessel has an "operational class"	K	A	K	K	K	A			A
		Consequence analysis	MTS Design sect. 14.15.1 / 22.6.1	Myth: The consequence analysis is calibrated to the FMEA	K	A	A	A	K	A			A

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