MARINE TECHNOLOGY SOCIETY – DP COMMITTEE

DP EQUIPMENT TESTING SUBCOMMITTEE

DP ASSET REACTIVATION GUIDANCE

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DOCUMENT INFORMATION

REVISION HISTORY

Rev	Date	Description	By	Checked	Approved
A	02/11/18	Preliminary Draft for Review & Comment	DPETS	DPETS	
B	03/20/18	Revised Draft for DP Committee Review & Formatting	DPETS	DPETS	
C	07/20/18	Revised following public comment period	DPETS	DPETS	

AMENDMENT RECORD

Revision	Description of Changes
A	Preliminary Draft – Revised from DPETS Rep001 and 002
B	Corrections to various Section references
C	Revisions based on public comments

DISCLAIMER

The information included in this document is for guidance and is intended to reflect recommended industry practice. Neither the Marine Technology Society, nor any of its Technical Committees or Sub-Committees, or their members, accepts any legal liability for errors, omissions or changes to the accepted state-of-the-art, nor for any consequences thereof.

EXECUTIVE SUMMARY

The principal goal of the DP Equipment Testing Subcommittee is to develop and maintain comprehensive guidelines for the testing of DP systems throughout the lifecycle of a DP capable asset. These guidelines will assist in outlining the critical issues to be considered when conducting the thorough testing of DP equipment and related systems. This sharing of knowledge is expected to help improve the reliability and performance of DP assets.

It is with this same goal in mind that the Subcommittee has embarked on a mission to develop guidance on the reactivation of DP capable assets, to improve the safety and efficiency of the reactivation process.

This document represents a practical compendium of recommended practices that includes existing guidance from various industry sources. Additionally, it relies heavily on the knowledge and expertise of members of the Subcommittee and participants in Subcommittee proceedings. It is recognized and intended that industry stakeholders responsible for the lifecycle operations of DP assets research and select items from this guidance with the goal of compiling a suitable strategy for their equipment package and specific industrial mission.

NOTE: It is the intent of this document to focus primarily on DP related systems and equipment. Therefore, it is not comprehensive. Other marine systems and industrial mission equipment may also be subject to lay-up and reactivation requirements. Every asset should be addressed bearing in mind its specific industrial mission and installed systems and equipment.

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1. OVERVIEW

1.1 Objective

1.1.1 The DP Asset Reactivation Guidance is designed to facilitate the return of DP assets to service and re-build confidence in systems critical to station keeping. It has been created to provide a clear path toward the safe and reliable reactivation of DP capable assets, emphasizing the positive influence of adequate preparation on safety, environment, and operational reliability.

1.2 Background

1.2.1 The offshore sector is subject to cyclical phases that result in varying degrees of demand for DP assets. Market trends may lower demand, resulting in a significant number of assets being deactivated for periods that range from weeks to months to years. As the cycle reverses demand increases for these same assets.

1.2.2 The safe and effective lay-up and maintenance of assets serve as critical means of achieving efficient reactivation. Efficient reactivation, however, must take place irrespective of the planning and activities that may or may not have taken place beforehand.

1.2.3 Upon reactivation, clients and charterers look to owners / operators for assurance that an asset and its equipment will continue to operate safely and reliably in the same manner as prior to lay-up. Likewise, Class societies and regulatory agencies seek verification that asset reactivation has been addressed in a suitable manner so as to reasonably assure continued safe and reliable operation.

1.2.4 The DP Asset Reactivation Guidance, therefore, is designed to support the return of DP assets to service safely, reliably, and efficiently regardless of the type of lay-up or level of preparation and maintenance. It documents the critical issues considered when undertaking reactivation with the objective of providing better guidance to stakeholders and re-build confidence in systems critical to station keeping following lay-up.

1.2.5 The industry wide sharing of knowledge represented by this guidance is intended to support the industry in improving reactivation safety and to further advance the reliability and performance of DP capable assets and the efficiency of overall DP operations.

1.3 Scope of Report

1.3.1 These guidelines are intended to cover the range of DP systems as defined in Guidelines for Vessels with Dynamic Positioning Systems, IMO MSC Circular 1580 (June 2017), section 1.2, as follows:

- *Dynamic Positioning control system (DP control system) means all control components and systems, hardware and software necessary to dynamically position the vessel. The DP-control system consists of the following:*
  - *computer system/joystick system;*
  - *sensor system(s);*
  - *control stations and display system (operator panels);*
  - *position reference system(s);*
  - *associated cabling and cable routeing; and*
  - *networks.*

- *Dynamic positioning systems (DP-system) means the complete installation necessary for dynamically positioning a vessel comprising, but not limited to, the following sub-systems:*
  - *power system;*
  - *thruster system; and*
  - *DP control system.*
- *Power system means all components and systems necessary to supply the DP system with power. The power system includes but is not limited to:*
  - *prime movers with necessary auxiliary systems including piping, fuel,*
  - *cooling, pre-lubrication and lubrication, hydraulic, pre-heating, and*
  - *pneumatic systems;*
  - *generators;*
  - *switchboards;*
  - *distribution systems (cabling and cable routeing);*
  - *power supplies, including uninterruptible power supplies (UPS); and*
  - *power management system(s) (as appropriate).*
- *Thruster system means all components and systems necessary to supply the DP system with thrust force and direction. The thruster system includes:*
  - *thrusters with drive units and necessary auxiliary systems including piping;*
  - *main propellers and rudders if these are under the control of the DP system;*
  - *thruster control electronics;*
  - *manual thruster controls; and*
  - *associated cabling and cable routeing.*
- *Computer system means a system consisting of one or more computers and associated hardware, software and their interfaces.*

1.3.2 It is the intent of this document to focus primarily on DP related systems and equipment. Therefore, it does not cover all types of vessels, installed systems or equipment. Other marine systems and industrial mission equipment may also be subject to reactivation following lay-up. Industry stakeholders responsible for the lifecycle operations of DP assets should research and select items from this guidance to compile a suitable strategy for their particular asset's equipment package and industrial mission.

1.3.3 Additional focus is provided for topics that are not noted in IMO's description above but could be relevant to asset owners and operators. These additional topics include:

- Personnel
- Class and Regulatory Considerations

1.3.4 This guidance contains sections outlining the following information:

- Definitions
- Protocols to be considered during the reactivation process
- Personnel considerations
- Class and Regulatory concerns
- Asset Systems and Equipment (various)
- References

1.4 Applicable Rules and Guidelines

1.4.1 Rules, regulations, requirements, and recommendations for reactivated assets are as varied as the assets themselves. In each case, direct reference should be made to:

- Class and Flag State requirements
- Asset Owner / Operator requirements
- Client / Charterer Requirements (as applicable)
- Original Equipment Manufacturer (OEM) or vendor recommendations
- General industry recommended practices (Institute of Electrical and Electronics Engineers [IEEE], International Marine Contractors Association [IMCA], etc.)

1.4.2 In no instance should the guidelines provided herein take precedence over applicable Flag State, Class Society, manufacturer, established owner / operator protocols or contractual covenants unless specifically discussed and agreed upon with all responsible parties.

1.5 Assumptions and Limitations

1.5.1 This guidance provides a general description of recommended practices for the reactivation of a DP related asset. Guidance for lay-up and maintenance of stacked assets is not provided within this document and no assumptions related to these activities is made herein.

1.5.2 It is envisioned that this guidance will be used strictly in conjunction with equipment and system documentation that is explicitly intended to reflect equipment installed on board. Accordingly, all equipment and system specific documentation should be reviewed and take precedence over any advice or instruction provided within this Guidance. Where specific guidance is not provided, OEMs and vendors should be contacted directly.

1.5.3 This guidance references recognized standards – directly or by reference – that, if followed, provide assurance that affected systems and equipment are adequately prepared for reactivation when returning to service.

1.6 Maintenance of Guidance

1.6.1 Reasonable efforts will be made to maintain this guidance in an up-to-date fashion at periodic intervals or if deemed necessary and appropriate to reflect relevant industry developments. Suggested maintenance procedures and equipment, industry guidance, and / or Class and Flag State requirements noted within these guidelines are subject to review and revision by numerous stakeholders at varying times with little or no notice to MTS. It is imperative that the most up-to-date references and documentation be consulted directly to ensure applicability and relevance to the equipment and systems installed on board any given vessel or asset.

1.6.2 Updated versions of this guidance will be made available on the MTS DP Committee website for use by interested parties. Updates may include:

- Information learned from market statistics
- Class, regulatory and industry standards
- Information volunteered to the Subcommittee toward improving the guidelines

1.6.3 All input and suggestions for correction and / or revision are welcome and can be provided directly to the MTS DP Committee, at info@mtsdpconference.com, referencing DP Asset Reactivation Guidance in the subject line.

2. DESCRIPTIONS AND DEFINITIONS

2.1 General

2.1.1 These guidelines do not take precedence over rules and requirements established by Class Societies, Flag State agencies, and other regulatory bodies.

2.1.2 While effort has been taken to establish consistency of terms and language throughout this document, there will be differences. Any inconsistencies that may lead to confusion or conflict within the guidelines provided herein should be brought to the attention of the MTS DP Committee and the DP Equipment Testing Subcommittee.

2.2 Terms

2.2.1 Terms such as “can,” “could,” “will,” “would,” “should,” etc. are used throughout these guidelines and are included to emphasize importance or likelihood. They are not intended to imply the imperative, or to reflect requirements or regulations unless attached to a specific reference.

2.2.2 Throughout these guidelines reference is made to asset “operator(s).” In this context the term “operator” is referring to the asset owner or operator, whichever is applicable, and refers to the party carrying principal responsibility over the asset.

2.2.3 Within the context of these guidelines, “lay-up” or “laid up” is used as a general term and refers to the inactive or out-of-service status of a vessel or asset. For the purposes of this guidance the use of either term bears no implication regarding the length of time the asset is out of service except as noted in Section 3. Nor does this terminology imply anything with regard to the reason behind this status for any specific asset.

2.2.4 References to High Voltage (HV) and Low Voltage (LV) systems and equipment are used within this guidance. Definition of each category may vary but adequate personnel and equipment safety measures should be considered and implemented regardless of designation. Unless otherwise specified, references herein consider HV systems to be operating at 1000 Volts or higher and LV systems to be operating at less than 1000 Volts.

2.2.5 Within the context of these guidelines, terms such as “Authorized Person,” or “Competent Person” refer to those individuals that are trained and certified to the appropriate level as per applicable Class, regional, or company requirements.

2.2.6 This guidance contains a number of references to Original Equipment Manufacturers (OEM). This term refers to the company or organization that manufactured any of the equipment, system, component, software, etc. installed on board an asset. It is noted that in some cases the vendor who supplied the equipment initially may not be the OEM, or that the equipment provided by the OEM is part of a larger system installation that may be better serviced by the vendor providing that part. When requesting assistance with specific equipment it will be determined on a case by case basis which is the appropriate company to contact. Throughout this document the terms OEM and vendor are used interchangeably and are not intended to imply any specific requirements.

2.3 Abbreviations and Acronyms

2.3.1 The following abbreviations and acronyms are used within this document.

Acronym / Abbreviation	Definition	Acronym / Abbreviation	Definition
ABS	American Bureau of Shipping	LV	Low Voltage
ACP	Alternate Compliance Program	MODU	Mobile Offshore Drilling Unit
ARA	Acoustic Riser Angle Monitoring	MRU	Motion Reference Unit
ASOG	Activity Specific Operating Guidelines	MSC	Maritime Safety Council (IMO)
BIOS	Basic Input / Output System	MTS	Marine Technology Society
BV	Bureau Veritas	NI	Nautical Institute
CAM	Critical Activity Mode	NVIC	Navigation and Vessel Inspection Circular
CFR	Code of Federal Regulations	OEM	Original Equipment Manufacturer
CMID	Common Marine Inspection Document	OS	Operator Station
DARPS	Differential Absolute and Relative Positioning System	OSVDPA	Offshore Service Vessel Dynamic Positioning Authority
DP	Dynamic Positioning	OVID	Offshore Vessel Inspection Database
DPETS	DP Equipment Testing Subcommittee	PIC	Person In Charge
DST	Decision Support Tool	PLC	Programmable Logic Controller
ERA	Electronic Riser Angle Monitoring	PMS	Planned Maintenance System
ECR	Engine Control Room	PMS	Power Management System
FMEA	Failure Modes and Effects Analysis	POC	Point of Contact
FMECA	Failure Modes and Effects Criticality Analysis	PROM	Programmable Read Only Memory
FO	Fuel Oil	PRS	Position Reference System
GLONASS / GNSS	Global Navigation Satellite System	PTW	Permit to Work
GPS	Global Positioning System	RCV	Remote Closing Valve
HT	High Temperature	RH	Relative Humidity
HV	High Voltage	ROV	Remotely Operated Vehicle
HVAC	Heating Ventilation and Air Conditioning	RPM	Revolutions Per Minute
I/O	Input / Output	SEMS	Safety and Environmental Management System
IEEE	Institute of Electrical and Electronics Engineers	SMS	Safety Management System

Acronym / Abbreviation	Definition	Acronym / Abbreviation	Definition
IJS	Independent Joystick	STCW	Standards of Training, Certification, and Watchkeeping
IMCA	International Maritime Contractors Association	TAM	Task Appropriate Mode
IMO	International Maritime Organization	UPS	Uninterruptible Power Supply
INS / IMU	Inertial Navigation System / Inertial Measurement Unit	USCG	United States Coast Guard
LO	Lube Oil	VCI	Vapor Corrosion Inhibitor
LOTO	Lock Out / Tag Out	VRU	Vertical Reference Unit
LR	Lloyd's Register	WCF	Worst Case Failure
LT	Low Temperature	WCFDI	Worst Case Failure Design Intent
LTW / TW	Lightweight Taut Wire / Taut Wire	WSOG	Well Specific Operating Guidelines

3. REACTIVATION ASSESSMENT TABLE

3.1 General

3.1.1 The main lay-up categories are commonly referred to as “hot,” “warm,’’ and “cold.” These categories may be defined based on numerous factors and can vary greatly between Class societies, regulatory bodies, and other industry groups. Due to the various interpretations, reliance on these terms is avoided within this document. Instead, this guidance focuses on the diverse factors to be considered when reactivating an asset from lay-up.

3.1.2 The Reactivation Assessment Table included below illustrates the four core categories to consider when planning and undertaking reactivation activities and lists the factors that may affect the determination of where an asset falls within those categories.

3.1.3 The Reactivation Assessment Table can be applied at the asset level or at the level of individual vessel systems or equipment units. Taken together, focused assessments at the system and equipment levels will provide a more robust determination of the overall status of the full asset (see also Section 3.4).

3.1.4 This guidance provides assistance in defining these categories and factors but final designation of an asset’s status is left to the owner / operator, the applicable Class society and regulator, and the asset’s charterer / client (if applicable).

3.2 Definitions

3.2.1 The categories of Planned Maintenance and Lay-Up Duration represent the two primary, quantifiable categories while Environmental Conditions and Lay-Up Preparation are more subjective.

3.2.2 The table further breaks down Planned Maintenance and Lay-Up Preparation categories into specific factors that further define these two core categories. Categories are further detailed below.

3.2.3 Lay-Up Duration is broken into five (5) time intervals listed across the top of the table. Intervals are broken down based on general maintenance periods frequently found within equipment maintenance programs. These intervals are used as guidance only and should be used in conjunction with the remaining three categories before a final determination of an asset’s status is made.

3.2.4 Planned Maintenance makes up the left side of the table and considers the level of planned maintenance activities applied to installed systems and equipment on a specific asset. Activities are recorded in maintenance systems providing evidence of actions carried out, parts replaced, etc. Further definition is provided as follows:

- Prescriptive – All normal maintenance activities take place as outlined within the applicable PMS. Activities are executed in a scheduled manner and adhere to OEM and industry recommendations.
- Routine – Most normal maintenance activities take place as scheduled within the applicable PMS. Maintenance based on running hours may not take place on unused equipment.
- Basic – Critical maintenance activities take place as scheduled within the applicable PMS.
- Minimal – Periodic checks are made on equipment to ensure no damage or potential major maintenance issues.

- None – No planned maintenance is carried out.

3.2.5 Environmental Conditions refers to the conditions in which the asset is laid-up, the conditions on board the asset itself, and/or storage conditions for equipment (where applicable). The category takes into consideration humidity, temperature, and cleanliness, and reflects interior / exterior conditions. Consideration should also be given to mitigations such as HVAC, exposure to elements, preservation techniques, etc.

3.2.6 Lay-Up Preparation considers the amount of planning, maintenance, and preventive measures carried out prior to the lay-up of an asset. Preparation levels are further defined below.

- Prescriptive – The asset was laid-up based on a strict lay-up plan.
- Preserve – Systems and equipment were subject to rigorous methods of preservation and protection. All systems were isolated and sealed as necessary and protected from the effects of heat and humidity.
- Protect – Reasonable steps were taken to protect installed systems and equipment from environmental impact (e.g. sealing, desiccant, heaters, etc.). Equipment and systems were isolated and secured as necessary.
- Isolate – Installed systems were shut down and secured. Valves, circuit breakers, etc., were secured in open / closed position as appropriate for specific systems.
- Shut Down – Systems and equipment were shut down with little or no means of protection or preservation.

3.2.7 It should be noted that all categories of Lay-Up Preparation are defined on a case-by-case basis and are provided as guidance only. Each level of preparation listed above varies based on the length of lay-up, maintenance category, etc. Irrespective of any one category, the final status determination may shift based on all factors taken together. Refer also to the application of the Reactivation Table as described below.

3.3 Application of Table and Guidance Document

3.3.1 The Reactivation Assessment Table should be read as two separate tables using both objective and subjective data to support planning and activities during reactivation.

3.3.2 As noted above, the table can be applied generally to the asset to give a high-level view of its status prior to reactivation. A more robust determination of this status may be obtained by applying the Assessment Table at the individual equipment and/or system level and using the results to generate a more detailed analysis.

3.3.3 “Planned Maintenance” and “Lay-Up Duration” represent two sources of quantifiable data. The length of lay-up should be cross referenced with the level of planned maintenance applied to the asset and its installed systems and equipment. The level of planned maintenance applied to the asset during lay-up should be supported by records and documentation of maintenance activities.

3.3.4 A secondary analysis of the Environmental Conditions and Lay-Up Preparation categories can then be used to further support the primary analysis or revise its conclusions. The conditions to which the asset and equipment were exposed during lay-up should be considered and then cross referenced with the level of lay-up preparation applied to same. Lay-up preparation may be supported by formal documentation (such as an approved lay-up plan) or may be corroborated through informal evidence provided by the asset owner / operator, shipyard, etc.

3.3.5 Following consideration of the primary analysis and any potential positive or negative effects of the secondary factors, an asset's status can be determined. This status should be discussed and a consensus reached between all commercial and regulatory stakeholders. Once finalized, this status can be used to assist in guiding an approach to reactivation using the guidance provided herein.

3.3.6 Status categorizations are briefly defined in the lower portion of the table and further described below. These definitions are intended only to support the decision-making process. Final designation of an asset's status is left to the owner / operator, in agreement with other concerned stakeholders.

3.3.7 **Green – Active:** The asset has been maintained in working status and is ready for immediate service.

3.3.8 **Blue – Ready:** The asset has been maintained in a reduced working status and is ready for service following review of maintenance tasks and minor operational checks.

3.3.9 **Yellow – Idle:** The asset has been laid-up for an extended period and/or has had reduced maintenance performed. A full review of planned maintenance should be considered and necessary operational checks carried out prior to service.

3.3.10 **Red – Inactive:** The asset and its installed equipment and systems have been static with little or no planned maintenance performed. A full critical maintenance review and operational testing regimen is recommended.

3.3.11 The reactivation procedures outlined in this guidance are general in scope and can be applied regardless of the agreed status. However, the extent to which the procedures are applied should be at the discretion of the asset operator in conjunction with OEM recommendations. Further stringent interpretations of guidelines may be deemed necessary by Class / regulators or following discussion and agreement with clients and charterers.

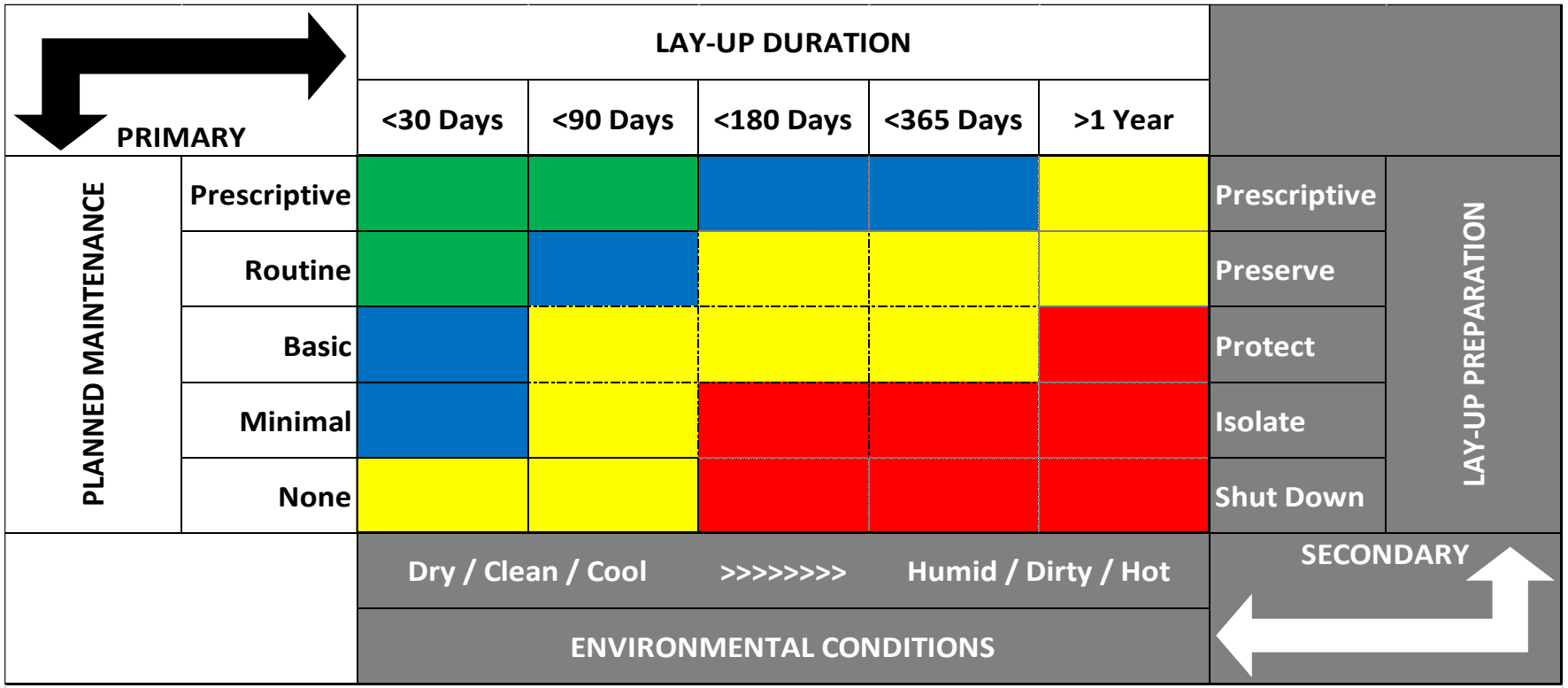
3.4 Scheduling

3.4.1 To assist in reactivation planning and budgeting, it can be assumed that both time commitment and cost generally increase when reactivating an asset from each of the *Active*, *Ready*, *Idle*, and *Inactive* categories, respectively. Estimates may only be inferred through interpretation of the Reactivation Guidance Table; exact costs can only be determined on an individual, case-by-case basis.

3.4.2 The Reactivation Guidance Table can be used as a tool to generate estimated time commitments based on the final, agreed status of the asset. More robust estimates may be generated by applying the focused assessments at the system or individual equipment levels.

3.4.3 OEMs, shipyard managers, third party consultants, etc. may be consulted to provide expertise during the assessment process based on the factors outlined on the table for an asset, a given system, or individual piece of equipment. Additional insight based on newbuild or refit commissioning experience may assist in generating scheduling estimates based on final assessment category.

Table 1: Reactivation Guidance Table



ACTIVE	**Asset is operational.**
READY	**Asset is ready for operation following maintenance review and operational checks.**
IDLE	**Asset may not be ready for immediate operation; full maintenance review and operational checks/testing should be considered before operations resume.**
INACTIVE	**Asset is not operational; critical maintenance review and operational testing recommended.**

4. GENERAL CONSIDERATIONS

4.1 General

4.1.1 Activities involved in the reactivation of DP capable assets are largely comprised of non-routine tasks that may not be addressed in established safe working protocols such as Permit to Work (PTW). As a result, these tasks pose significant safety risks to operating personnel as well as a potentially significant number of third party personnel and should be risk-assessed in accordance with the appropriate Safety Management System (SMS) or equivalent.

4.1.2 All non-routine tasks and the personnel required for their safe completion should be managed with due consideration of the unique risks involved. It should be noted that additional risk is inherent in reactivation activities by nature of the shortened timelines that may be applied.

4.1.3 It should be noted that many spaces will have been closed during lay-up, potentially with poor or no ventilation, for a significant length of time. Re-entry to these spaces should be undertaken following confined space entry procedures until the atmosphere can be proven to be safe. Greater care will need to be taken when entering machinery spaces or holds where there is a greater possibility of oxygen depletion.

4.1.4 In all cases, consult directly with equipment manufacturers, specialists, Class Societies and regulatory agencies to ensure that all requirements and proper safety protocols are in place and sound practices are followed.

4.2 Communications Equipment

4.2.1 Communication equipment refers to voice transmitting, general electronic communications, audible and visual signals and alarms, emergency notification methods, etc. The types of systems installed, the industrial mission of the asset, and the immediate work scope for the asset immediately following reactivation should be considered during the reactivation period and given appropriate priority during the reactivation process.

4.2.2 Data communications within specific systems are not included in this category and are covered within appropriate sections of this guidance.

4.3 Software Management

4.3.1 Asset owners / operators should communicate with OEMs to determine coordination and timing of necessary software and firmware updates during the reactivation and testing processes.

4.3.2 If software for a DP system and its related systems and equipment were fully functional before lay-up, they should theoretically revert to a fully functional state (depending on conditions, damage, etc.). Consequently, reactivation of the DP system and all of its relevant equipment does not necessarily mean or require updating any software or firmware unless it is determined to be a safety related issue.

4.3.3 Regardless of operational state, software and firmware updates in the form of technical bulletins, notifications, etc. should be tracked for all relevant equipment and systems. If an update is deemed necessary, precautions should be taken by reviewing software change notes and witnessing testing of the change before implementation.

4.3.4 Consider that the applicable software version may not necessarily be the most recent version; rather it may be dependent on the interfaced systems and equipment, length of lay-up period, etc. Similarly, software and / or firmware versions may need to be updated in stepwise fashion to ensure that all updates are compatible. Equipment manufacturers should be contacted directly regarding the most suitable course of action.

4.3.5 With the assistance of the OEM or vendor, asset operators should ensure that they have the software update(s) most applicable to the systems and equipment as suggested by the OEM. Document the software and firmware versions in the equipment to be tested and confirm that software is updated to the most appropriate version and that all affected systems and equipment are tested for compatibility.

4.3.6 Upon reactivation all computers (Automation, DP, PRS, etc.) should have the time verified in the Basic Input / Output System (BIOS).

4.3.7 If equipment is disconnected I/O and data communications should be verified post reconnection.

4.3.8 Depending on the type of equipment control system in focus, there may be a need to reinstall software to PLCs and / or system controllers. A back up of the PLC "PROM" program should be stored as part of software management protocol and in accordance with OEM recommendations. This will allow for a program restore in the event of loss.

4.4 Reactivation

4.4.1 Ensure that proper reactivation protocols for all equipment are developed and properly implemented. This may vary from thruster type and thruster manufacturer – refer to specific manufacturer's guidance, as appropriate.

4.4.2 Create a checklist identifying the support and materials required for reactivation. Request supplies and support well in advance of reactivation. These may include:

- Technical support.
- Manufacturer / Vendor support.
- Third party surveyor/auditor support.
- Class and Flag State regulatory support.
- Consumables (lubricating oil, hydraulic oil, additives, flushing fluids, etc.).
- Tools and equipment.

4.4.3 The reactivation timeline would depend on several factors, such as:

- Length of lay-up
- Conditions during lay-up
- Extent of lay-up preservation (i.e. corrosion inhibiters, desiccants, etc.)
- Cleaning, preparation, maintenance, and reactivation requirements for specific equipment and systems
- Quality and extent of applied maintenance routines (focusing on state of mechanical equipment, rotating devices, electrical circuits / equipment, electronics, etc.)
- Quality and extent of condition surveys
- Recommissioning requirements for key equipment and systems
- Class required surveys, testing, sea trials, etc.
- Client / contract obligations including modifications required

- Facilities required and available (location, shipyard facilities, personnel, etc.)

4.4.4 Considerations during reactivation should include:

- Completing all due and deferred maintenance
- Depending on lay-up preparation, duration of lay-up, and other factors (refer to Reactivation Table, Section 3), certain systems and equipment may need to be recommissioned prior to operational service
- Booting up and updating of computer systems. Tested, verified and restoring from backup if required. Monitoring, alarms and control to be re-confirmed (refer also to software considerations outlined in Section 4.3)
- A DP trials program to re-establish the fault tolerance, detection and protection of the electrical power system

4.4.5 Class societies may require the submission and approval of a reactivation plan and subsequent reactivation survey for assets returning to service from lay-up. It is the asset operator's responsibility to contact Flag administrations for any specific regulations and requirements.

4.4.6 It is recommended that a reactivation survey be completed – regardless of Class requirements – to verify that the asset is in conformance with the applicable Class rules and requirements. OEMs, vendors, shipyards, etc. may be able to provide guidance on the suggested content of reactivation surveys to include checklists, testing protocols, etc. If necessitated by Class, the proposed procedures will be reviewed and approved per Class requirements.

4.4.7 The reactivation survey should be developed with due consideration of the lay-up procedure and comprising of recommissioning considerations. The reactivation survey will vary in intensity depending on the length of the lay-up, the extent and detail of lay-up precautions followed, and the maintenance procedures during the lay-up period.

4.5 DP Documentation

4.5.1 Regardless of type or duration of lay-up DP documentation should remain relevant at time of reactivation unless exceeding prescribed time limits. The requirement for a periodical survey at intervals not exceeding five years in IMO MSC 1580 generally aligns with Class survey requirements. This would indicate that as long as reactivation occurs within the five-year testing cycle (per the date of the most recent FMEA / FMECA) all DP related documentation should still be considered applicable and not in need of revision.

4.5.2 If the asset has undergone upgrades, modifications, software/firmware updates, or equipment changes significant enough to warrant Class review, these changes should be recorded and DP documentation (FMEA, Trials, checklists, CAM / ASOG, etc.) updated accordingly. Updates should consider the effects of system and equipment modifications to the asset's redundancy philosophy and DP capabilities.

4.5.3 If changes have not been applied to the relevant DP documentation, additional testing should be considered at the time of reactivation. Results of testing or analysis that indicate system or equipment changes have impacted an asset's redundancy philosophy or DP capabilities should be recorded and highlighted for inclusion in future analysis and testing.

4.6 Documenting and Reporting Lessons Learned

4.6.1 Recording lessons learned should be included as one of the key objectives of the reactivation process.

4.6.2 Documenting such items supports continuous improvement in the reactivation process and can provide valuable information within the organization for present and future reactivation activities. Additionally, the sharing of such lessons widely is key to improving the safety and efficiency of similar reactivation activities across the industry.

4.6.3 General documenting/reporting considerations incorporating lessons learned during reactivation include, but are not limited to:

- Safety concerns
- Environmental considerations
- Maintenance recommendations
- Condition monitoring considerations
- Spare parts recommendations
- Scheduling factors
- Budgeting factors
- Written summary report

4.6.4 In all applicable cases incidents, accidents, and near-misses should be reported through appropriate channels and in accordance with implemented SMS or equivalent. Where possible, however, lessons learned should be clearly differentiated from incident or near-miss reports to avoid misunderstanding and unnecessary delays in promulgating learning opportunities.

4.6.5 The value generated by lessons learned is exponential to the amount of circulation to which they are subject. Conscious efforts should be made to distribute learnings to as broad an audience as achievable.

4.6.6 Companies preferring or requiring anonymity should still consider disseminating learnings broadly; the value of lessons learned is not reduced if an asset or its owner / operator cannot be identified.

4.6.7 NOTE: There is currently no official, industry-wide mechanism for distributing lessons learned during reactivation activities. MTS DP Committee welcomes the submission of lessons learned and, where necessary, will commit to respecting anonymity of submitters. The MTS DP committee will consider and discuss distribution methods with industry stakeholders and incorporate lessons into future guidance, as applicable.

5. PERSONNEL

5.1 General

5.1.1 Depending on the stage of reactivation, various specialist personnel will need to be involved in the operation. These may include specialized technicians, Class and third-party surveyors, local port control, and government agencies. Coordination and communication between all parties should be effectively managed, with a single Point of Contact (POC) designated.

5.1.2 Where applicable, all personnel should be covered under the appropriate overarching Safety and Environmental Management System (SEMS) and/or specific Safety Management System (SMS) or equivalent. Work performed during reactivation should be conducted per the requirements of the SMS.

5.1.3 All work undertaken throughout the reactivation process should be completed using an appropriate PTW system, typically managed under a single authorizing authority or responsible person in accordance with the asset's SMS, or equivalent. This person will control the system and ensure that simultaneous operations can be performed safely, as well as ensuring area safety, compliance with permit requirements, liaising with shore-based personnel, etc.

5.2 Competence

5.2.1 Regardless of job description or function, all personnel should be adequately trained for their given responsibilities and for the safe execution of their assigned duties. Typically, this will be managed through existing guidance for training and certification of personnel, or qualification requirements of contractor companies.

5.2.2 In the case of marine crews involved in the project, existing regulations for competency and training will apply, for example the Standards of Training, Certification, and Watchkeeping (STCW) for marine licenses on assets over 200 gross registered tons, or relevant marine endorsement as required by the Flag State. Dynamic Positioning specific endorsements from a recognized training provider should be held by relevant personnel as required. Technical marine staff should have training that is OEM specific to the systems installed onboard, including type specific DP system maintenance certification and HV training as required.

5.2.3 Third party technicians will typically be vetted by their employers but will likely not carry a standardized certificate of competency for their field, as this is often determined by on the job training. In these cases, it is the responsibility of the person in charge (PIC) of the operation to suitably vet the service providers. In practice, there should be an existing relationship in place and, where possible, the use of contractors already familiar with the asset is preferred.

5.3 Testing and Reactivation

5.3.1 In preparation for reactivation it is preferable to utilize the same personnel that were present for the lay-up activities, to ensure continuity of information and experience. If the same personnel are not available, then the quality of the documentation generated during the lay-up period will be extremely important. In either case, collection of documentation and identification of third party personnel required will be the first step when reactivating.

5.3.2 A checklist of equipment and processes to be completed in addition to an estimated time table or Gantt chart should be generated prior to beginning the reactivation. Such tools should be continuously updated during the reactivation process.

5.3.3 A DP-specific trials program should be developed and approved by class as required. This should be completed by a suitably qualified assurance provider such as original DP FMEA provider. The scope of the DP test program will be determined by a number of factors, not least of which is the length of lay-up (see also Section 12).

5.3.4 Due to the potential for lack of continuity of personnel performing the reactivation, the Person in Charge (PIC) should be the asset's Technical Superintendent, or similar. They will need to work in cooperation with the senior crew onboard, for example the Master, Senior DPO, and Chief Engineer. Any specialist electrical technicians normally carried should also be a staple part of the reactivation team.

5.3.5 Special attention must be given to safety of operations during the reactivation and testing process, as there will be simultaneous operations ongoing with hazardous conditions resulting from the stacked period that were previously not in place (e.g. insufficient ventilation internally due to closed dampers). As such, the asset operator's (or shipyard's) PTW system must be fully activated and controlled by a suitably qualified person as per the company's procedures; most often this will be the Master or designated individual. All work must be managed through the PTW system.

5.3.6 The asset's Classification Society should be given as much forward notice as possible so they can be involved throughout the project reactivation. Class may be able to assist with a list of mandatory testing that will be required, based on the length of the lay-up.

5.3.7 The asset's operational crew or company-assigned maintenance team may be called upon to conduct the initial phase reactivation. This will comprise reactivation of basic systems (i.e. HVAC, power to accommodations, etc.). Following this there will be a requirement for attendance by specific equipment technicians to aid in bringing those specific items back online.

5.3.8 Prior to testing for reinstatement of Class notation / certificates it is advisable to conduct pre-trial testing to ensure proper function of all equipment and operation of the asset. A sufficient number of correctly trained and qualified personnel will need to be on board to complete this.

5.4 Critical Personnel Considerations

5.4.1 Note that the following list is by no means exhaustive and does not imply that all listed personnel will be required for every reactivation activity. It serves to demonstrate the various personnel that may need to be involved in the reactivation process. Personnel actually required will be dependent on circumstances and will need to be evaluated on a case-by-case basis.

5.4.2 Personnel that are critical through various phases of the project include:

- Asset crew
- Owners / Operators representative
- Technical Superintendent or PIC
- Classification Society
- Flag State Authorities
- Coastal State Authorities

- Insurance company representative
- Marine Warranty Surveyor(s)
- Third Party DP Consultant(s)
- Shipyard personnel
- Harbor Master
- Maintenance team
- Safety personnel
- Marine chemist
- Firefighting and emergency response team
- Radio equipment technicians
- Security team
- Mission critical equipment technicians
- OEM / Equipment Vendors
- Charterer / Client Representative

5.4.3 Wherever possible, OEMs should be included as part of the reactivation team to verify the integrity of their specific equipment and ensure that all appropriate maintenance is completed.

5.4.4 Equipment manufacturers to consider as part of the DP reactivation team(s) include, but are not limited to, the following systems:

- Dynamic positioning system
- Switchboards
- Power management system
- Integrated automation system
- Thruster drives and controllers
- Thrusters
- Engines and gearboxes
- Generators and power distribution
- Position reference systems
- Networks, gateways, and switches
- Mission critical equipment with inputs fed into DP, as required

5.4.5 Good communication is required throughout and lines of communication should be well established and utilized by all attending parties. Continuity of personnel should be maintained whenever possible.

6. CLASS AND REGULATORY CONSIDERATIONS

6.1 General

6.1.1 This guidance has been generated as an assistance to asset operators and is not to be interpreted as required by any regulatory agency.

6.1.2 Due to the variation of applicable regulatory frameworks which may be in place, Class and Regulatory concerns are to be considered on a case-by-case basis, prior to commencement of reactivation activities. For example, each asset could have any combination of the following key stakeholders to be consulted:

- Flag State
- Classification Society (Recognized Organization)
- Coastal State
- Marine Warranty Surveyor
- Client/Charterer Representative

6.1.3 The approximate length of the lay-up period will be the first consideration made by Class and may determine the level of testing and assurance required during the reactivation process. In addition, each organization may have a very different set of requirements which must be followed when reactivating a DP capable asset. It is therefore important that requirements of each stakeholder are carefully considered and prioritized during reactivation. In many cases, multiple bodies may share the same requirements. Varying regional requirements may also apply.

6.2 Reactivation

6.2.1 Depending on the length of the lay-up period, the asset may be required to undergo a full special survey in order to have its Class notation reinstated. Proper guidance and Class involvement throughout the lay-up cycle will ensure that the final reactivation process is completed as smoothly as possible. By adhering to Class requirements from the outset it may be possible to reduce the amount of verification required during the reactivation process.

6.2.2 Reactivation of an asset following lay-up can require an extensive survey by the Classification Society. To ensure that this process runs smoothly, the pre-approved lay-up plan should be precisely followed throughout the lay-up period.

6.2.3 Additional consideration and planning should be made to allow for performance testing requirements. Such requirements will vary depending on the unit's regulatory compliance framework, in particular its DP notation. Examples of such requirements may include testing of power distribution systems and verification of position keeping capabilities.

6.2.4 Further discussion is provided in Section 12.

6.3 Maritime Requirements

6.3.1 Information regarding applicable maritime requirements can be obtained from the appropriate regulatory authority.

6.3.2 Please also see References.

6.4 Exemptions

6.4.1 All applicable exemptions from Class or Statutory requirements should be adequately prepared, applied for and approved in advance of such code or rule being contravened.

6.4.2 For the asset design rules in effect after lay-up refer to applicable Class rules.

6.4.3 For changes in Class status (Laid Up, Inactive, Suspended, etc. versus “active”) as a result of lay-up, deactivation, or other stated period of inactivity, local attending Class Surveyor should be contacted for any ‘Alternative Procedures” before a planned lay-up.

6.4.4 Likewise, local attending Class Surveyor should be contacted regarding required Surveys and testing upon reactivation.

7. DP CONTROL AND MONITORING SYSTEMS

7.1 General

7.1.1 Differences in the nomenclature used within this section may differ from one manufacturer to another. Further, the equipment list covers commonly installed equipment but should not be considered exhaustive.

7.1.2 In all cases, refer to the equipment manufacturer for specific instructions.

7.1.3 DP Control and Monitoring System components may include:

- DP Sensors
  - Wind sensors (Mechanical/Analogue/Ultrasonic)
  - Gyrocompasses (Mechanical/Digital/Fiber Optic)
  - Motion or Vertical Reference Units (MRU or VRU)
  - Draught Sensors
- DP Position References Systems
  - Global Navigation Satellite System (GNSS) with Differential corrections on Global Positioning System (GPS), GLONASS, Galileo, BeiDou, etc.
  - Hydro-Acoustics (Hydrophones, Beacons, Transponders and Transceivers)
  - Riser Angle Monitoring (Electronic (ERA) or Acoustics (ARA))
  - Taut Wire (TW)
  - Laser-Based Position Reference Systems
    - Fanbeam
    - CyScan
    - Spot Track
  - RADAR-Based Position Reference System
    - RADius
    - RadaScan
    - Artemis
  - Differential, Absolute, and Relative Positioning System (DARPS)
  - Inertial Navigation System (INS) or Inertial Measuring Units (IMU)
- DP Alert and Communication Functions
- DP Data Loggers / History Station
- Printers
- Stand Alone Simulators
- Independent Joystick System (IJS) or DP Backup System
- Thruster Control System
  - Field Stations
    - Processors (PLC/Controllers)
    - Remote Input/Outputs (I/O)
    - Power Supplies
- Uninterrupted Power Supply (UPS)
  - Battery Cabinet

- DP Consoles
  - Monitors
  - Marine Computers
  - Power Supplies
  - Keyboard / Control panel with trackball, joystick, and heading knob
  - Main DP Processors / Controllers
- Communication (refer also to Sect. 4, Communications)
- Control Networks
  - Network Distribution Units (Network Switches)
  - Network Patch Panels (copper/fiber)
  - Emergency Shutdown Systems
  - Gateway connections
  - Malware barriers
  - Cyber security tools and protocols
- Non-DP, Interfaced Equipment (Mission Specific)
  - Diving
    - Dive status lights (Diving Bell)
  - Gangway (flotel)
  - Dredging system
  - Heavy lift / Crane
  - Offloading (Shuttle Tankers & FPSOs)
  - Anchor Handling
  - Drilling
    - Electronic Riser Angle (ERA) sensors
    - Acoustic Riser Angle (ARA) sensors
    - Riser tensioner stroke-out meter
    - Top tension gage
  - Pipe / Cable Laying
    - Pipe or cable tension gage(s)
- Non-DP, Interfaced Equipment (General)
  - External force compensation
  - Draught sensors
  - Emergency Shutdown Systems (ESD)
  - Fire and Gas Systems (F&G)
  - Power control interfaces for industrial equipment
  - Power and circuit breaker status for DP control system
  - Power distribution for industrial consumers
  - Power distribution for life support consumers
  - Fixed firefighting systems – water mist – CO2
  - Communications equipment
  - Navigation equipment
  - Roll compensation
  - Anti-heeling systems

7.1.4 In all cases, refer to the equipment manufacturer for specific instructions.

7.2 Reactivation

7.2.1 Prior to commencing reactivation, ensure that supporting documentation is available including specific guidance and procedures provided by the OEM.

7.2.2 All DP systems and associated / interfaced equipment should be thoroughly inspected. If units have been stored appropriately, check all storage materials and media for indications of physical damage due to dropping, moisture intrusion, corrosion, or other mishandling.

7.2.3 If the units carry no physical damage, check condition and state of desiccants for indication of excessive moisture. Make note of any potential indications of moisture intrusion.

7.2.4 If an electronics cabinet shows indications of salt exposure while it was in lay-up, it should be thoroughly cleaned both internally and externally (refer to manufacturer documentation and instructions). Damaged or suspect areas should be cleaned, prepared and preserved using the correct preservation media for the unit. The recommended media will usually be defined in the unit's maintenance manual.

7.2.5 If a mechanical unit shows indications of salt exposure while it was in lay-up, it should be thoroughly cleaned both internally and externally to prevent corrosion (refer to manufacturer documentation and instructions).

7.2.6 If equipment has been removed, units should be installed in their intended operating position as soon as possible after unpacking. No power should be provided to the equipment until all necessary pre-checks are completed.

7.2.7 If disconnected during the lay-up phase, batteries will be reconnected during the reactivation procedure. Batteries should be recharged and checked regularly ensuring proper charge storage and general operating parameters.

7.2.8 Take all necessary precautions in handling units with energy storage capabilities or equipment that is susceptible to electro-static discharge. Energy discharge may harm personnel and damage equipment.

7.2.9 When reactivating sensitive electronic equipment, suitable precautions must be taken (refer to manufacturer documentation and instructions as well as industry recommended practices such as those provided by IEEE).

7.2.10 As part of the reactivation process and subsequent testing, battery endurance tests should be carried out for a minimum of 30 minutes with the system on load in accordance with Class requirements and industry recommended practice.

7.2.11 Any performance issues with any equipment should be well documented to ensure that on reactivation, any pre-existing problems with equipment are understood to be present prior to preservation rather than as a consequence of it.

7.2.12 NOTE: Once all pre-checks are complete and the DP system powered up satisfactorily, the testing method required for the applicable DP notation should be discussed and established. Refer to Section 12, Testing for Reactivation.

8. POWER GENERATION AND DISTRIBUTION

8.1 General

8.1.1 In all cases, refer to the equipment manufacturer for specific instructions.

8.1.2 The primary electrical components include, but are not limited to:

- Generators
- Motors, pumps, coolers, RCVs, starters
- Propulsion (diesel electric)
- DP Control System

8.1.3 Only personnel deemed competent will perform work on electrical equipment once a risk assessment has been completed and under the direction of an Authorized Person, in accordance with applicable requirements. Opening the protective barriers and / or covers of electrical equipment should be done only by a Competent Person in accordance with proper risk assessment procedures and after an Authorized Person has issued a PTW.

8.1.4 Detailed procedures should be made available for:

- Reactivation of each item of HV electrical equipment
- Switching plan for reactivation

8.2 Reactivation

8.2.1 Before power is applied to each item of equipment at reactivation, checks/procedures to be completed as part of reactivation in accordance with manufacturer documentation and instructions.

8.2.2 General considerations before and during reactivation of power generation and distribution equipment include, but are not limited to:

- Verification of crew familiarity with systems and equipment operations, maintenance, etc.
- Inspection of maintenance and operational history of the equipment; perform overdue and/or recommended maintenance as per OEM specifications and PMS
- General, visual inspection of cleanliness and overall condition
- Clean the devices and surrounding areas
- Check of safety interlocks
- Verification of all functions
- Carrying out verification of closing / opening operations of contacts, breakers, etc.
- Condition / integrity check of connectors and contacts
- Conduct insulation / Megger testing
- Visual inspection and integrity checks of Protection Relays
- Function test including verification of inputs/outputs from protection relays and check of software revisions
- Battery survey and testing
- Remove additional heaters, thermostats, desiccant materials, etc. (as applicable); restore space heater control to original functionality (as applicable)
- Visual inspection of general system and equipment condition
- Spare parts recommendations

9. MAIN AND AUXILIARY ENGINES

9.1 General

9.1.1 In all cases, refer to the equipment manufacturer for specific instructions.

9.1.2 When reactivating marine engines, due consideration must be given to related, critical auxiliary systems such as fuel oil, lubricating oil, and cooling systems. During reactivation, delays or equipment damage may occur if related systems are not returned to a fully operational state.

9.1.3 Refer also to Section 11, Marine and Auxiliary Systems.

9.2 Reactivation

9.2.1 Reactivation from any state of inactivity generally follows reversal of initial preservation techniques. In all cases, refer to the builder, equipment manufacturer, or vendor for specific instructions.

9.2.2 Considerations during reactivation should include OEM recommendations on the following:

- Running engines with preservative oils in the lubrication oil or whether a complete oil change is recommended
- Confirm condition/cleanliness of all filters and strainers
- Inspect spaces on, in, and around engine including crankcase
- Ensure all clearances (i.e. valve tappets, bearings, etc.) are confirmed
- Confirm condition of all fittings, bolts, etc. to include proper status of critical fasteners related to cylinder heads, main bearings, foundation, etc.
- Verify start up sequence to ensure all systems are ready. For example:
  - Pre-lubrication time
  - Rotate engine on turning gear (number of turns and frequency as prescribed by manufacturer)
  - Run fuel oil boost pump; Bleed air from the system
  - Ensure all control and protection systems are powered up
  - Mechanical fuel racks are free
  - Cooling water systems vented
  - First start protocols such as run times between initial crankcase and bearing temperature inspections

9.2.3 Consideration should be given to flexible hose connections to engine auxiliary system (inspection or replacement).

- Fuel oil supply and return lines
- Cooling water (freshwater and seawater)

9.2.4 Sea strainers and through hull fittings should be considered for inspection and review

9.2.5 Ensure water treatment levels are correct concentrations, cooling water loops are free to circulate, and there are no leaks.

10. PROPULSION AND THRUSTERS

10.1 General

10.1.1 In all cases, refer to the equipment manufacturer for specific instructions.

10.1.2 This section reflects all types of thrusters and thruster equipment as listed below:

- Azimuth thrusters
- Tunnel thrusters
- Cyclonical thrusters
- Water jets
- Propeller / Rudder combination
- Controllable pitch propellers
- Fixed pitch propellers
- Remote manual thruster controls
- Thruster / machinery emergency stops

10.2 Reactivation

10.2.1 In preparation for reactivation it is recommended to follow the manufacturers' instructions and procedures.

10.2.2 As a minimum the crew should follow the instructions within thruster documentation. Within these documents the asset operator should have documentation and/or checklists covering shipyard testing, harbor acceptance testing, and sea trial acceptance testing.

10.2.3 Prior to commencing reactivation all units should be thoroughly inspected. If units have been stored or preserved in place, check all storage and preservation materials and media for indications of any physical damage due to impact, moisture intrusion, corrosion, etc.

10.2.4 In the event that damage is discovered, an inspection report should be written and submitted in accordance with Company procedures, including appropriate SMS and any Lock Out / Tag Out (LOTO) protocols. Report should state the condition of the unit and actions taken. Describe the damage and collect documentary and/or photographic evidence if possible. The damaged equipment should be removed from service and quarantined.

10.2.5 Hydraulic and lubricating oil should be addressed according to OEM recommendations, to include possible replacement at reactivation. Oil samples should be taken and provided for analysis after a specific run time as prescribed by the equipment manufacturer.

10.2.6 All cabinet (thruster control, drives etc.) is to be inspected for condensation or other damages incurred during lay-up. As necessary, they should be thoroughly cleaned prior to be energized (refer also to Sections 7 and 8).

10.2.7 Associated transformers, drives and motors should follow the guidance notes set forth in applicable guidance for transformers, drives, and motors (refer to Section 8, above).

10.2.8 Any batteries removed should be reinstalled and charged prior to use. Where batteries have not been removed or replaced a discharge test should be performed ensuring can maintain the minimum required capacity.

10.2.9 Batteries for PLC power within Thruster / Propulsion cabinets should be installed. In this case, PLCs should be uploaded with the correct programming (a copy of the software should be part of the software management plan). Batteries should be recharged and checked regularly ensuring proper charge storage and general operating parameters.

10.2.10 A visual inspection of all systems should be carried out including cabinets, electrical wiring, piping, valves, coolers, tanks etc. to ensure that all systems are ready for startup. It is very important to ensure that valves on the thruster unit are open / closed as per intent. A closed valve can cause pressure build up or an open will cause a leakage, both cases can cause damage to the thruster or propulsion unit. An example is a wrongfully closed valve causing pressure build resulting in damaging of the lip seals, thus leakage of oil into the environment.

10.2.11 Immediately prior to start up, ensure that all accumulated moisture or dust is removed from the system. Typical procedures for this are normally covered in OEM documentation.

10.3 Thruster Tuning / Scaling

10.3.1 At time of reactivation and testing/trials it is important to ensure that the thruster pitch and/or RPM settings for zero and 100% are confirmed as set correctly both from thruster or drive side and within the DP control system. Correct azimuth settings (for azimuthing thrusters) should likewise be confirmed.

10.3.2 Scaling and tuning of thrusters and propulsion should take place between individual thruster units and each point of control, including:

- DP system (including joysticks and remote-control locations)
- IJS
- Manual levers

10.3.3 To ensure this is completed in an effective manner it is recommended that both thruster and DP system OEM / vendor simultaneously witness calibration and testing to avoid potential discrepancies.

11. MARINE AND AUXILIARY SYSTEMS

11.1 General

11.1.1 In all cases, refer to the equipment manufacturer for specific instructions.

11.1.2 Systems include:

- Fuel
- Ventilation and Combustion Air
- Compressed Air
- Seawater Cooling
  - Sea chests
  - Through hull fittings
- Freshwater Cooling
- Lubrication
- Hydraulic
- Emergency shut down systems
- Fire and gas

11.1.3 It is recommended to document the normal operational state of all valves and the state at which they were left during lay-up. When the asset is brought back into operation, delays or equipment damage may occur if cooling systems or lubrication systems are not returned to a fully operational state.

11.2 Reactivation

11.2.1 Systems consisting of primarily static components such as piping and valves are subject to considerable issues stemming from corrosion and general deterioration. The longer the lay-up period and greater this risk becomes.

11.2.2 From any sate of lay-up, certain checks and procedures should be considered in order to verify that all marine and auxiliary systems are ready for full operation. In a normal state of operation, checks are normally covered in routine maintenance, checklists, and other established procedures. Additional checks and protocols may be applicable following significant maintenance periods or following a prolonged lay-up period and dependent on preservation techniques applied.

11.2.3 Reactivation from any state of inactivity generally follows reversal of initial preservation techniques. In all cases, refer to the builder, equipment manufacturer, or vendor for specific instructions.

12. TESTING FOR REACTIVATION

12.1 General

12.1.1 The narrative below provides guidance for the testing that is to be considered when reactivating a stacked asset. The approach to testing will be dependent upon several factors to include the time that the asset has been stacked, the maintenance program applied, the lay-up conditions, and the degree of preparation undertaken prior to lay-up.

12.1.2 In preparation for reactivation it is recommended to follow the manufacturers' instructions and procedures.

12.2 Benefits of Testing

12.2.1 There would be several benefits to a well-developed and executed test program:

- Demonstrates that the asset's DP system is reinstated to its original, fully operational condition
- Confirms that the asset is fault tolerant according to the pre lay-up equipment Class requirements
- Gives the asset operator an opportunity to witness certain operational modes or configurations that they otherwise may not see
- Technical staff have an opportunity to increase their understanding of the failure modes of DP system components and the successful reconfiguration and/or re-instatement of those components
- Builds confidence in the asset and plays an important role in crew training and competence

12.3 DP FMEA and Proving Trials

12.3.1 As part of the FMEA development, a set of FMEA Proving Trials should have been conducted to validate the original DP FMEA. Proving Trials focus on verifying that the Worst-Case Failure Design Intent (WCFDI) is not exceeded and that failure effects are as expected. This testing may also include exploratory trials designed to provide additional information about how the redundancy concept functions.

12.3.2 One of the primary objectives of the FMEA Proving Trials is to add new knowledge to the FMEA process. This objective differs from that of reactivation testing as this FMEA exploratory analysis has been performed and verification testing completed during the original process. Therefore, execution of the full FMEA Proving Trials should be considered but repeating the associated testing again should not be required unless there have been significant changes made during lay-up or as part of the reactivation process.

12.3.3 While full retesting may not be required, changes to systems or equipment may warrant additional testing if required by Class or indicated as necessary by OEM. In addition, changes to Class or Regulatory requirements or industry recommended practices may merit consideration of additional testing.

12.4 Developing a Test Program

12.4.1 It will be the asset operator's responsibility to ensure that an effective DP trials program is developed and implemented. This testing program may be comprised of an existing DP trials program or a new program designed specifically as a reactivation procedure.

12.4.2 The operator should ensure that a suitably qualified and experienced person, group or third party executes this task (personnel are addressed in Section 5).

12.4.3 The time the asset spends in lay-up will influence the testing to be carried out. If the lay-up period is lengthy, technology and operating practices may change significantly during that time and may require additional due diligence and / or testing to incorporate the necessary changes.

12.4.4 Likewise, if equipment is disconnected I/O and data communications should be verified post reconnection. The level of verification necessary should be considered during the development of the test program.

12.4.5 Performance – By requirement, DP assets of equipment Classes 2 and 3 must have at least two redundant equipment groups each capable of developing surge, sway, and yaw forces. In dual redundant systems, each redundant group must have sufficient performance to independently maintain the asset's position and heading at its predetermined limits. In redundant systems of three or more equipment groups, the failure of any one group will likewise not result in a loss position and heading at the predetermined limits of the remaining equipment groups.

12.4.6 Tests coming under the heading of performance may include:

- Generator full power tests – To prove the full load capability and load acceptance of the generators. Generators should be loaded to 100% until temperatures stabilize.
- Thruster full power tests – This test will prove the full power capability of the thrusters. Thrusters will be loaded to 100% until temperatures stabilize.
- Group redundancy tests – This test should prove the asset can maintain position and heading with the loss of a redundant group of propulsion machinery. The asset needs to be able to hold position and heading after the loss of each redundant group identified by the FMEA. Loss of one group is likely to represent the Worst-Case Failure (WCF).
- Transferable, dual fed and standby equipment tests – These tests are intended to prove the effectiveness of switchable redundancy such as transferable generators or thrusters with dual supplies but also auto changeovers for UPSs. Tests should be created to exercise the changeover function or dual supply.
- Functional testing – Functional testing of the DP control system comes under the performance category. This will include but not limited to, testing of various DP modes:
  - Independent Joystick (IJS) and DP joystick
  - automatic positioning (including auto sway, surge, and yaw) capabilities
  - changeover of operator stations and DP control computers
  - testing of essential communications including DP alert system
  - testing of manual thruster controls
  - testing of consequence analysis function
  - testing of mathematic model / dead reckoning function
  - specific functions, operating modes, and equipment related to the asset's industrial mission

12.4.7 Protection – Each redundant group will also have a range of protective functions designed to prevent fault propagation from one redundant group to the other by way of common points in the design and a range of alarms or other detection methods intended to help reveal hidden failures that could defeat the redundancy concept.

12.4.8 Testing should be designed to prove the operation of all protective functions upon which the redundancy concept depends. A review of the FMEA should identify all protective functions which need to operate effectively to isolate faults or prevent cascade failures. Tests should be carried out in all relevant power plant configurations. Tests coming under the heading of protection may include but not be limited to:

- Load dependent starting of standby generators
- Alarm starting of stand-by generators in response to alarm on running generator
- Load shedding – thruster phase back (via DP control system, PMS, and Drives)
- Load shedding – preferential trips of non-critical equipment
- Advanced generator and bus tie protection
- Thruster emergency stops
- Protective functions intended to reject faulty DP control sensors
- Protective function intended to reject faulty DP control reference systems

12.4.9 It is important that all protective functions upon which the redundancy concept depends are proven with a high degree of confidence and that they will operate successfully on demand.

12.4.10 Detection – These tests are designed to prove the effectiveness of alarm and indications intended to alert the operator to potential hidden failures or that some part of the redundancy concept is not functioning correctly and may require operator intervention. Tests falling under this category include but not limited to:

- Thruster speed and azimuth command/feedback prediction errors
- Alarms and indications for thrusters ready, running and enabled
- Alarms for unscheduled stop of machinery
- Alarms for start of a standby pump or other service
- Control loop failure alarms (input errors)
- Alarms to indicate that a UPS or 24Vdc battery system is on battery power
- Alarms to indicate that a backup supply has failed
- Alarms related to pressure/temperature in cooling water systems
- Indication that a standby generator is no longer available
- Alarms to indicate network failure

12.4.11 In all cases, refer to the equipment manufacturer for specific instructions.

12.4.12 Ensure that proper reactivation protocols for all equipment are developed and properly implemented as outlined within this document or applicable industry guidance.

12.4.13 Create a checklist identifying the support and materials required for reactivation testing. Request support well in advance of reactivation. These may include:

- Technical support
- Manufacturer or vendor support
- Third party surveyor/auditor support
- Class and Flag State regulatory support

12.4.14 Acceptance Testing should include the verification of as much functionality as is practical for the given state of the asset. Testing should include all equipment and related auxiliary systems supplied by, or deemed the responsibility of, the manufacturer and / or vendor. Additionally, all interfaces to other equipment and systems should be confirmed. Where possible the procedure should show pass / fail criteria or desired results for each item.

12.5 Liaising with Classification Society and Charterer / Client

12.5.1 The proposed trials program should be submitted to Class for review and acceptance at the earliest opportunity if required by Class. Attendance of a Class surveyor is advisable. Section 6 of this document outlines Class and Regulatory considerations.

12.5.2 In instances where an asset is being reactivated for a specific project, the proposed testing program should be discussed with the charterer or client to ensure that any concerns they may have are addressed. Clients may wish (and may be entitled under regulatory mandate) to have a representative on board to witness reactivation activities and testing.

12.6 Conducting Acceptance Testing

12.6.1 All stakeholders witnessing Acceptance Testing should assure that:

- All specified equipment, related systems, and interfaced equipment and systems (as appropriate) are thoroughly tested and in compliance with agreed specifications, including any change orders.
- Equipment complies with all applicable standards and / or regulations referenced in the specification. All supplied drawings, manuals, and other related documentation is likewise in compliance.

12.6.2 Upon completion of testing, all witnesses should be satisfied and in agreement that all requirements for safe and effective operation have been met.

12.6.3 Any deviation from written procedures should be accurately recorded and documentation maintained for later reference to include reason for deviation, what (if any) follow up actions were taken, and any resolutions reached.

12.7 Specific Equipment Acceptance Testing

12.7.1 Following significant lay-up, it is at times deemed necessary that specific equipment be tested and verified as operational by the equipment manufacturer. When necessary, testing should be conducted formally and be witnessed by the asset operator or by a designated representative. Relevant Class Societies, Flag State regulatory agencies, and client(s) may also be present to witness testing for critical equipment.

12.7.2 All applicable standards and requirements should be specified, discussed, understood, and agreed upon by all concerned parties.

12.7.3 Manufacturer and / or vendor responsibilities include, but are not limited to:

- Preparation and submittal of the Specific Equipment Acceptance Test procedure well in advance of testing. This procedure should be reviewed and approved by the asset operator or a designated representative and by the applicable Class Society, Flag State regulatory agency, and client as deemed necessary.
- Ensuring that all equipment is fully pretested prior to Acceptance Testing.
- Confirming that all necessary documentation is completed and approved by Class or Regulatory Agency as required.
- Providing or making suitable arrangements for provision of all necessary test equipment.

12.7.4 All testing procedure and results should be recorded. Testing documentation should include functionality testing and any Class and regulatory testing. As above, any deviation from expectations should be accurately recorded and documentation maintained for later reference. This may include reason for deviation, what (if any) follow up actions were taken, and any resolutions reached.

12.7.5 *Ad hoc* testing may be required to define and address any major non-conformities revealed during testing.

12.8 Review of Acceptance Test Results

12.8.1 Following satisfactory completion of testing, all concerned parties should review and confirm that all documentation is updated and approved as necessary. This may be completed by an assigned assurance group on behalf of a client but may be performed by an owner/operator to ensure understanding of installed systems and equipment by operational crew.

12.8.2 Check that all third-party design reviews are complete and approved. Manufacturers and / or vendors should provide schedule for completing any remaining documentation and estimated time for submittal to Class and Flag State / regulatory bodies for review and approval as deemed necessary.

12.8.3 The manufacturer and vendor should maintain a record of discrepancies and non-conformities in a formal register. Documentation should include criteria and processes as to how these issues should be addressed. Timeline for completion should also be provided.

12.8.4 Follow up with the manufacturer or vendor should be made periodically to ensure items are addressed in a timely manner.

12.8.5 Closeouts of discrepancies and non-conformities should be recorded and supporting documentation maintained for reference in relevant documentation including, but not limited to the FMEA, PMS documentation, and logbooks and provided to all relevant crew and operational staff.

12.9 Suitability/Fitness for Purpose Surveys

12.9.1 In addition to the assurance tests that have been developed the asset may also require other assurances. Subjects generally covered include but not limited too are:

- Review of the FMEA including action taken to close out findings
- Review of the previous annual DP trials including action taken to close out findings
- Review of OVID / CMID including action taken to close out findings
- Review of DP capability plots
- Review of the training and experience of key DP personnel
- Review of DP operations manual and associated checklists or procedures to include Decision Support Tools (DST) such as the Critical Activity Mode (CAM), Task Appropriate Mode (TAM), and Activity Specific Operating Guidelines (ASOG) as applicable
- Review of critical spares for DP system components
- Review of planned maintenance of DP system components

12.10 Other Considerations for Planning and Testing

12.10.1 At the time of reactivation, the industrial mission of the asset and the immediate work scope following its return to service should be considered. If the asset will not be required to fulfill its industrial mission (such as DP operations) immediately following reactivation an assessment and subsequent prioritization of “mission critical” equipment should be performed.

12.10.2 This assessment and prioritization may determine the timeline for reactivating specific equipment and systems. For example, if an asset is due to transit to a new location prior to carrying out DP operations, prioritization may be given to primary propulsion equipment with other DP critical equipment being addressed later. This will be determined on a case-by-case basis and any prioritization based on agreement and understanding between all appropriate stakeholders.

12.10.3 During the trials, all relevant equipment should tested in fully operational condition in accordance with OEM and industry guidelines. All propulsion units and their controls, both manual and automatic, all power generation equipment, all computer systems and all position reference systems need to be fully functional, including their alarms, standby units, battery backups, shutdowns, trips, etc.

12.10.4 It must be ensured that the asset is set up with the correct equipment configuration for each test. The correct configuration of equipment should be described in the FMEA and / or FMEA Proving Trials and should correspond to the expected operating configuration in DP as laid out in applicable checklists, DST, etc. The FMEA / FMECA should take precedence if a reactivation testing program provides an alternate operating mode, unless safety of personnel or equipment is a concern.

12.10.5 During trials and / or testing, the asset’s regular operating crew should assist as required in recording alarms and failures locally.

12.10.6 Following failure tests, the system should not be reinstated until the DP operators, ECR staff and witnesses are satisfied they understand the full effects of the failure and that all the information or indicators that show what has occurred have been noted.

12.10.7 When reinstating systems after failure simulations, verify that all equipment has been returned to the correct operating configuration, breakers have been reset, power supplies re-established, cables reconnected, etc. Only when everyone is satisfied that the system has been reset correctly and has stabilized should testing continue.

12.10.8 If there are any doubts about a test, it should be repeated. If test results are unexpected, then the test should also be repeated. It should be noted that seemingly small or spurious faults in DP control systems may be the first manifestations of a more serious problem.

12.10.9 No maintenance on DP critical equipment should be ongoing during testing. If maintenance is required, testing should be ceased until all necessary repair tasks are completed.

12.10.10 Tests should proceed only when all those involved have been informed and (where necessary) suitable communications have been set up.

13. REFERENCES

13.1 Reference Documents

13.1.1 The below documents and materials are referenced for general information only and served as a basis for the section contents. These references, like this Guidance, in no way supersede or take the place of specific manufacturer's recommended procedures, Class Society or Flag State requirements, or Company generated guidance.

13.1.2 The following guidelines and requirements were used for the development of this document:

- ABB; ABB Stacking Care – Maintenance routines in each phase; ABB Marine and ports, November 2016
- ABB Combustion Engineering Systems; *Marine Boiler Operating Guide*; Columbus, OH; Grade A Notes
- Alternate Compliance Program (ACP) Supplements – ABS, DNV GL, Lloyds, etc. (http://www.uscg.mil/hq/cg5/acp/)
- American Bureau of Shipping; *Guide for Lay-up and Reactivation of Mobile Offshore Drilling Units;* Houston, TX; May 2016
- Bureau Veritas, Guidance Note NI545 DNS R00 E – *Guidance for Lay-Up of Ships*; April 2009
- DNV GL; *Lay-up of Vessels*; March 2012
- DNV GL; *Procedure for the lay-up of Mobile Offshore Units*; April 2015
- GAC Ship Lay-Up Solutions (GLUS), Bibby Ship Management & DehuTech; *Guidelines for Lay-Up of Ships*
- Hunt, Everett C. 1999/2002; *Modern Marine Engineer's Manual, Volumes I & II*, Third Edition; Centreville, Maryland: Cornell Maritime Press, Inc.
- IMCA C010 – *High Voltage Training*
- IMCA C002 – *Guidance on Competence Assurance and Assessment*
- IMCA M166 – *Guidance of Failure Modes & Effects Analyses (FMEAs)*
- IMCA M190 – *Conducting Annual DP Trials Programmes for DP Vessels*
- IMCA M191 – *Annual DP Trials MODUs*
- IMCA M117 – *The Training and Experience of Key DP Personnel*
- IMCA M212 – *Format of the Annual DP Trials Program*
- IMCA M219 – *Example Specification for a DP FMEA for a New DP Vessel*
- IMO MSC 1580 (formerly MSC 645) – *Guidelines for Vessels with Dynamic Positioning Systems*
- The International Convention on Standards of Training, Certification, and Watchkeeping for Seafarers (STCW)
- Marine Safety Manual Vol. II Section B, COMDTINST MI6000.7B Ch.1.
- MTS DP Committee; Technical and Operational Guidance (TECHOP) – TECHOP_ODP_09_(D) – A Method for Proving the Fault Ride-Through Capability of DP Vessels with HV Power Plant, May 2015
- MTS DP Committee; Technical and Operational Guidance (TECHOP) – TECHOP_ODP_01_(D)_(FMEA TESTING), October 2013
- MTS DP Committee; Technical and Operational Guidance (TECHOP) – TECHOP_ODP_03_(D)_(EVALUATION OF PROTECTION SYSTEMS), September 2012

- MTS DP Committee; Technical and Operational Guidance (TECHOP) – TECHOP_ODP_08 – Annual DP Trials and Gap Analysis
- Mutual Recognition Agreement / Marine Equipment Directive (http://www.mared.org/bal_ims_person_controler.php).
- Navigation and Vessel Inspection Circular (NVIC) 2-95 (http://www.uscg.mil/hq/cg5/nvic/nvic.asp).
- Navigation and Vessel Inspection Circular (NVIC) 8-91 (http://www.uscg.mil/hq/cg5/nvic/nvic.asp).
- Navigation and Vessel Inspection Circular (NVIC) 10-82 (http://www.uscg.mil/hq/cg5/nvic/nvic.asp).
- Navigation and Vessel Inspection Circular (NVIC) 10-92 (http://www.uscg.mil/hq/cg5/nvic/nvic.asp).
- Title 46 Code of Federal Regulations 61 (http://www.ecfr.gov/cgi-bin/ECFR?page=browse).
- Title 46 Code of Federal Regulations 62 (http://www.ecfr.gov/cgi-bin/ECFR?page=browse).
- Title 46, Code of Federal Regulations, Subchapter L.
- USCG Certified Equipment (http://cgmix.uscg.mil/).
- USCG MSC MTN 2-11 and Plan Review Guidance (https://homeport.uscg.mil/mycg/portal/ep/home.do).
- USCG Policy Letter, 24 July 2015; *Laid-Up Status Policy for Offshore Supply Vessels & Small Passenger Vessels*.

APPENDIX A SAMPLE RUBRIC AND INSTRUCTIONS

A.1 SAMPLE RUBRIC

A.1.1 Overview

A.1.1.1 This section provides a general example of the application of the Reactivation Assessment Table (from Section 3) as a rubric. This serves only as an example and can be modified or revised based on the needs of individual stakeholders.

System or Equipment Specific Assessment / Full Asset Assessment - Combined & Weighted								
PRIMARY		LAY-UP DURATION						
		<30 Days	<90 Days	<180 Days	<365 Days	>1 Year		
PLANNED MAINTENANCE	Prescriptive	25	24	20	18	9	Prescriptive	LAY-UP PREPARATION
	Routine	23	22	13	11	8	Preserve	
	Basic	21	17	12	10	7	Protect	
	Minimal	19	16	6	5	3	Isolate	
	None	15	14	4	2	1	Shut Down	
		Dry / Clean / Cool >>>>>>>> Humid / Dirty / Hot					SECONDARY	
		ENVIRONMENTAL CONDITIONS						

SYSTEM AND / OR EQUIPMENT	DP Control & Monitoring Systems	Power Generation & Distribution	Main & Auxiliary Engines	Propulsion & Thrusters	Marine & Auxiliary Systems	TOTAL ASSET SCORE
Primary Score:						0
Secondary Score:						0
TOTAL WEIGHTED SCORE:	0	0	0	0	0	0

A.1.2 Instructions

A.1.2.1 System / Equipment Assessment:

(1) Each system is scored, first considering the Primary categories of Lay-Up Duration and Planned Maintenance. The score is then inserted into the appropriate cell.

(2) A follow up assessment is performed using the Secondary categories of Environmental Conditions and Lay-Up Preparation with scores assigned independently of the Primary categories. This score is likewise input into the appropriate cell.

(3) Each system then receives a Total Weighted Score as calculated using the Primary and Secondary assessment score. The weighting can be determined on a case-by-case basis. As example only, a weighting formula is shown below using a simple average of the Primary and Secondary assessments:

$$Total\ Weighted\ Score = \frac{Primary\ Score + Secondary\ Score}{2}$$

(4) Each system undergoes a similar process and receives a Total Weighted Score calculated as above.

A.1.2.2 Full Asset Assessment:

(1) Using the Total Weighted Score of the individual system assessments, the full asset may then be assessed as demonstrated below (example only):

$$Asset\ Total\ Weighted\ Score = Sum\ of\ individual\ Total\ Weighted\ Scores$$

(2) The asset's overall status is then determined based on the same rubric as used for the individual system assessment with the colored categories defined according to the original table and definitions provided in Section 3 and assessed according to the same table as provided for individual systems.

A.1.3 Alternative Interpretations

A.1.3.1 This Sample Rubric is provided as an example only. Numbers are assigned based solely on a general interpretation of the four categories and their impact on equipment operating condition and status.

A.1.3.2 Numbers can be interpreted as needed but for this example provide a general overview of condition and operating status.

A.1.3.3 Numbers assigned to each cell may be replaced by general monetary amounts or time scales that better reflect the specific considerations of an asset's owner / operator or other stakeholder.

APPENDIX B ASSESSMENT EXAMPLE

B.1 ASSESSMENT EXAMPLE

B.1.1 Overview

B.1.1.1 In this section, a worked example is provided to demonstrate the application of the Assessment Table using the Sample Rubric provided in Appendix A.

B.1.1.2 This serves only as an example. The rubric may be laid out and the asset scored based on the specific requirements of the vessel owner / operator or on those requirements deemed appropriate by the assessing stakeholder.

B.1.2 Hypothetical Asset and Lay-Up Details

B.1.2.1 Asset details, lay-up conditions, and other considerations are as follows:

Asset Type	Lay-Up Duration	Lay-Up Location	Planned Maintenance	Lay-Up Preparation	Lay-Up Environment
DPS-2 (Classed)	**200 days**	**Active shipyard**	**System-specific**	**System-specific**	**External: Subtropical** **Internal: System-specific**

B.1.3 Assessment

B.1.3.1 Each system is scored, first considering the Primary categories of Lay-Up Duration and Planned Maintenance. A follow up assessment is performed using the Secondary categories of Environmental Conditions and Lay-Up Preparation with scores assigned independently of the Primary categories.

<u>DP Control & Monitoring System</u>

- The asset and equipment were laid up for a period of 200 days. Basic maintenance only was performed on the DP control and monitoring system. It was not subject to operation for the duration of lay-up.
  - PRIMARY SCORE: 10
- Batteries in the DP control and monitoring system were removed. Conditions at the lay-up location were humid and dirty. However, air conditioning was provided to bridge electronics and accommodation spaces. Desiccants were placed in sensitive electronic panels and overall conditions were monitored periodically throughout the duration of lay-up and basic steps taken to mitigate effects of environment.
  - SECONDARY SCORE: 13

<u>Power Generation & Distribution</u>

- The asset and equipment were laid up for a period of 200 days. Minimal maintenance was performed on the power generation and distribution equipment.
  - PRIMARY SCORE: 5

- Similar to other electronic control systems, batteries in the system were removed. Conditions at the lay-up location were humid and dirty and no air conditioning was provided to any machinery spaces. However, heating elements and other measures were taken to assist in protecting and preserving generators and distribution panels. In addition, all sources of potential power were isolated appropriately.
  - SECONDARY SCORE: 11

Main & Auxiliary Engines

- The asset and equipment were laid up for a period of 200 days. Basic maintenance was performed on the engines and other rotating equipment to include periodic, manual rotation of engines.
  - PRIMARY SCORE: 10
- Conditions at the lay-up location were humid and dirty and no air conditioning was provided in machinery spaces. Engine fuel and lubrication systems were isolated and drained where necessary but no preservatives added. Overall conditions were monitored periodically throughout the duration of lay-up and basic steps taken to mitigate effects of environment.
  - SECONDARY SCORE: 7

Thrusters & Propulsion

- The asset and equipment were laid up for a period of 200 days. No maintenance was performed on the thrusters and propulsion equipment. Systems and equipment were not subject to operation for the duration of lay-up.
  - PRIMARY SCORE: 4
- Propulsion equipment was shut down at time of lay-up. Some systems drained and isolated but no preservatives added. Thruster drives were covered with protective sheeting to prevent dust and debris from entering electric windings.
  - SECONDARY SCORE: 3

Marine & Auxiliary Systems

- The asset and equipment were laid up for a period of 200 days. Prescriptive maintenance was performed on systems to include operations of critical valves and periodic operational checks of pumps, motors, etc.
  - PRIMARY SCORE: 18
- As above, systems were drained and provided with a thorough cleaning prior to being shut down. Main systems were provided with additives to prevent internal corrosion. Fire main systems and critical hotel systems such as air conditioning were maintained in an operational status and maintained accordingly.
  - SECONDARY SCORE: 18

B.1.4 Scoring

B.1.4.1 Each system's score is then inserted into the appropriate cell with calculations (for this example) made based on the weighing calculations outlined above.

B.1.4.2 Scores assigned, as follows:

SYSTEM AND / OR EQUIPMENT	DP Control & Monitoring Systems	Power Generation & Distribution	Main & Auxiliary Engines	Propulsion & Thrusters	Marine & Auxiliary Systems	TOTAL ASSET SCORE
Primary Score:	10	5	10	4	18	9.4
Secondary Score:	13	11	7	3	18	10.4
TOTAL WEIGHTED SCORE:	11.5	8	8.5	3.5	18	9.9

B.1.5 Interpreting System and/or Equipment Scores

B.1.5.1 Each system is provided with an individual, weighted score based on the sample rubric and formulas provided in Appendix A. The conditional status of each system is determined based strictly on the number assigned. Asset owners can use this number to determine the amount of resources – in terms of time, personnel, or financial requirements – to assign to each aspect of reactivation.

B.1.5.2 In this specific example, it is clear that category of Propulsion & Thrusters will require the largest investment of resources during the reactivation process. The combined impact of the given environment and levels of maintenance and preparation over the period of lay-up negatively impacted the overall score.

B.1.5.3 The category of Power Generation & Distribution will require the next greatest amount of resources. However, it is noted that despite the low Primary Score assigned during the assessment, the relatively higher score assigned during the Secondary Assessment as a result of the level of Lay-Up Preparation reduced the impact of time and environment and improved the overall score.

B.1.5.4 The categories of DP Control & Monitoring Systems and Main & Auxiliary Engines will require somewhat less resources due to increased levels of Planned Maintenance as well as the relatively higher amount of Lay-Up Preparation.

B.1.5.5 Of the five categories, Marine & Auxiliary Systems will require the least amount of resources as a result of the application of prescriptive levels of Planned Maintenance and Lay-Up Preparation.

B.1.6 Interpreting Total Asset Score

B.1.6.1 The Total Asset Score, in this example, serves as an overall evaluation of the asset and provides a general determination of the amount of resources needed for reactivation.

B.1.6.2 Reference the Sample Rubric in Appendix A, it would be of interest to note that the minimum score that could reasonably be expected – based on Duration of Lay-Up – would be in the vicinity of 10 to 11. The actual overall score of 9.9, however, is slightly

lower. As a result of lower levels of Planned Maintenance and Lay-Up Preparation, the actual score reflects that of an asset that was laid up for a year or more instead of 200 days.

B.1.7 Alternative Interpretations

B.1.7.1 Similar to the Sample Rubric provided in Appendix A, this Example Assessment is provided as an example only. Numbers can be interpreted as needed but for this example provide a general overview of condition and operating status.

B.1.7.2 Numbers assigned to each cell may be replaced by approximate monetary amounts or time scales that better reflect the specific resources under consideration by the appropriate stakeholder.