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The Evolution and Divergence of DPO Competency: Commonalities and Differences in the Competencies Required of DPOs across Industry

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Abstract:

This paper describes the evolution of guidance and standards that have shaped current DPO training and certification processes. By comparing the evolution of these processes to the exponential growth and diversification of DP utilization within the offshore industry, this paper provides context and justification for this evolution. Subsequently, the paper presents a summary of a gap analysis between the existing DPO competency guidance and current DP operational best practices in use aboard offshore service vessels and discusses how information put forth by the IMO, IMCA, DNVGL, MTS and the Nautical Institute has been analyzed and integrated to create a new system for defining the training, evaluation, and certification process necessary to develop DPO competency for the offshore service vessel Industry.

First DPO Certification Scheme:

In 1983, the first iteration of the Nautical Institute's DPO certification scheme was approved by a large contingent of the oil industry. Subsequently, the certification scheme was approved, "for any DSV or other DP-operated vessel working within any designated 500 meter zone" (The Nautical Institute, 2014).

As a certification system crafted and promulgated by the users of DP at the time, which were predominately dive support and construction vessels. As the operation of these vessels are typified by long periods of DP stationing-keeping activities, the Nautical Institute scheme was based on sea time accrual.

Since the adoption of the Nautical Institute's DPO certification scheme guidance and standards from other stake holders in the DP industry has steadily progressed, with the industry issuing new and more sophisticated documents every few years.

The biggest change to the Nautical Institute's scheme during the first 25 years of its existence came in 1994—ten years after its initiation—when the Nautical Institute added a "Limited" certificate for those who had completed their sea time on DP-1 vessels. This change was made as a result of industry pressure upon the Nautical Institute to expand its view of what constituted DP operations worthy of certification (Giddings, 2004).

1996 Release of IMCA M 117:

In 1996, IMCA published IMCA M 117, *The Training and Experience of Key DP Personnel* (referred to as IMCA M 117). This document represented the first DP guidance developed by a broad base of stakeholders.

The release of IMCA M 117 also represented the first time a document laid out explicitly what DPO training courses should entail (Appendixes 2 and 4), what skill sets those involved in DPO should have (Section 4), and the levels of experience vessel owners should expect of those who handle DP technology (Section 5) (The International Marine Contractors Association, 1996). This document was also the first time structured assessments of a DPO's competency were called for, "satisfactory performance at the induction and simulator course shall be formally assessed by an examination or equivalent method" (The International Marine Contractors Association, 1996).

In many respects, the document was before its time. When IMCA M 117 was first published, the Nautical Institute was issuing fewer than 250 DPO certificates per year (The Nautical Institue, 2013); all of which came from just three accredited training academies (Giddings, 2004), and most—if not all—of these certificates were provided to those in the oil or diving industry.

Thus, the DP industry didn't necessarily need the standardization provided by a defined list of competencies or structured assessments because most of the participants knew and were familiar with each other. A fact IMCA M 117 itself acknowledges this fact in Section 10, which allows those who have been in the DP industry for a significant amount of time to bypass the training if they can prove their competency in a simulator onboard a vessel (The International Marine Contractors Association, 1996).

DNV 3.322:

The first true competency guidance for DPOs was released in 2009 by DNV. Called the DNV Standard for Certification Number 3.322, *Competence of Dynamic Positioning Operators Station-Keeping* (referred to as DNV 3.322), the document "intends to capture the most important competencies for DPOs, irrespective of the type of vessel, trade, or activity" (Det Norske Veritas AS, 2009).

In many respects, DNV 3.322 is an extrapolation of the competencies listed in IMCA M 117, breaking each task, responsibility, and action listed in IMCA M 117 down into its fundamental elements.

Table 1: Comparison of Competency Descriptions Between IMCA M 117 and DNV 3.322

DPO competencies in alarm recognition and response as detailed in IMCA M 117*	DPO competencies in alarm recognition and response as detailed in DNV 3.322**
[His/her knowledge and experience should include] system redundancy, alarms and warnings (4.3.2(v))	Determine and set alarm and warning limits (3.7.11)
[His/her knowledge and experience should include] Knowledge of DP alarm sequences and communications with reference to operational condition (4.3.2(vii))	Recognize alarms which may interfere with a proper operation of the DP-system and maintaining position (3.7.12)
	Discuss alarms with Engine Control Room (3.7.13)
	Evaluate the possible consequences of each alarm (3.7.14)
	Identify the procedures to follow for DP and non-DP alarms (3.7.16)
	Acknowledge alarms within time constraints (3.7.17)
	Decide to continue or to abort an operation after analyzing alarms (3.7.20)

* (The International Marine Contractors Association, 1996)
** (Det Norske Veritas AS, 2009)

DNV 3.322 is also important in that it represents the first guidance issued recognizing the connection between competency in manual operations, and competency in DP operations. As such, DNV 3.322 included the following subsection detailing what manual operating competencies the DPO should possess. The inclusion of this subsection demonstrates the increasing utilization of DP on a broader scope of vessels, as drill ships and MODU-based DPOs seldom control the vessel manually

Table 2: Manual Control Competencies in DNV 3.322

ID No.	Defined Activity (To be preceded by, "The DPO shall be able to. . . .")
3.3	*Vessel under manual control*
3.3.1	Describe advantages/disadvantages of various types of main propulsion, rudders and thrusters with regard to manual manoeuvring.
3.3.2	Discuss special precautions to be taken due to wind, current, waiver height and swell during manual manoeuvring close to installations or other obstructions.
3.3.3	Stop the vessel at a pre-determined position
3.3.4	Explain the reason for stopping the vessel completely before switching to DP control
3.3.5	Test manoeuvring stations
3.3.6	Demonstrate manual manoeuvring of the vessel
3.3.7	Demonstrate manual station-keeping of the vessel

(Det Norske Veritas AS, 2009)

Manila Amendments to STCW Code:

The next significant development in DPO certification was the revisions to the *International Conventions on Standards of Training, Certification and Watchkeeping for Seafarers* (STCW Code), made during a conference in Manila, Philippines in 2010 (Manila Amendments). The Manila Amendments added to the STCW Convention Section B-V/f "Guidance on the training and experience for personnel operating dynamic positioning systems" (The International Maritime Organization, 2010)

This section represents guidance as it was included in Part B of the Code; however, the inclusion marked the first time IMO addressed the competencies of DPOs. As such, the inclusion is an interesting indicator into what factors were deemed integral to the competency of a DPO.

It is important to note that the section repeatedly mentions "training and experience" highlighting the maritime industry's belief that experience—as measured by sea time—is as important to competency as classroom or simulator-based instruction.

Additionally, Section B-V/f continues the precedent set in IMCA M 117 by acknowledging the diversification of DP usage and the effect these different uses has on DPO competency by stating "[u]pon appointment to a vessel operating in DP mode, the master, DPOs and other DP-trained personnel should be familiarized with the specific equipment fitting on and the characteristics of the vessel. Particular consideration should be given to the nature of the work of the vessel and the importance of the DP system to this work" (The International Maritime Organization, 2010).

Absent from Section B-V/f is a guideline detailing a line-item specific definition of competency for DPOs. In fact, only two subsections mention items DPOs should have knowledge of, with B-V/f(3) mentioning seven DP systems or subsystems that should be covered in the training and B-V/f(4) providing two phrases: "[t]raining and experience should cover the range of routine DP operations, as well as the handling of DP faults, failures, incidents and emergencies," and "DPOs should be knowledgeable of the type and purpose of the documentation associated with DP operations, such as operational manuals, Failure modes and Effects Analysis (FMEAs) and capability plots" (The International Maritime Organization, 2010).

Norwegian Maritime Authority's Regulation No. 1523:

Following the Manila Amendments to the STCW Code, the Norwegian Maritime Authority promulgated the first flag-state requirement for those operating DP systems. Specifically, Section 71(3) of the Regulations of 22 December 2011 No. 1523 required:

> Operators of dynamic positioning systems shall have completed training in the operation of such system and be qualified in accordance with an internationally recognized industry standard. The training shall at least include DP control station, power generation and management, propulsion unites, position, training and environmental reference systems and external force reference systems, including hawser tension gauges (Norwegian Maritime Authority, 2011).

As Section 71 is applicable only to self-propelled mobile offshore units, the section is limited in actual impact. However, the Section is viewed as precedent for expansion to other areas of DP.

DNV/SMSC Certification Scheme:

The following year, DNV released a concept for a DPO certification scheme. Established via a partnership with the Ship Modelling and Simulation Center, AS (SMSC), in Trondheim, Norway, this scheme was billed to provide "a new and flexible way of achieving a DP Operator Certificate containing a high quality and faster throughput than the existing schemes" (Det Norske Veritas AS, 2012). The concept gained clout in June of 2012 when the Norwegian Maritime Authority approved the concept finding it "to be equivalent to international recognized standard. Therefor the NMA requirement is fulfilled when a person holds a valid DNV DP certificate" (Norwegian Maritime Authority, 2012).

Interestingly, this approval references a "DNV DP certificate" while DNV claims it only certifies the testing and training centers. In fact, DNV's press release announcing the NMA's decision states, "a DNV Approved DP Test Centre certificate that permits the approved test centre to issue DPO certificates." (Det Norske Veritas AS, 2012). This discrepancy continues to cause confusion today.

The DNV standard is based upon a combination of other DNV standards, specifically:

- Standard for Certification No. 3.406 *Test Centre for Certification of Personnel*, October 2011
- Standard for Certification No. 3.322 *Competence of Dynamic Positioning Operators Station-Keeping*, October 2009
- Standard for Certification No. 2.14 *Maritime Simulator Systems*, January 2011
- Standard for Certification No. 3.201 *Learning Programmes*, April 2011
- Standard for Certification No. 3.403 *Maritime Simulator Centres*, February 2005
- Standard for Certification No. 3.324 *Competence of Marine Simulator Instructors*, October 2009
- Standard for Certification No. 3.323 *Competence of Maritime Teaching Professionals – Course Designers, Teachers, Lecturers, Trainers, Instructors, Assessors*, October 2009 (Norwegian Maritime Authority, 2012).

As seen in in this list of standards, the DNV's certification program is a collection of DNV SeaSkill standards relating to how DPOs should be assessed, the types of equipment which should be used during training and assessments, the requirements of training providers and testing centers, all combined with the previously-described DNV 3.322. DNV utilizes these standards to audit training providers and test centers in order to give that entity the ability to issue DPO certificates.

The next year (2013), the DNV concept was realized when the first DNV-approved SMSC scheme was opened to the public (MarineLink.com, 2013). This scheme is marked by three primary features.

First, the scheme could be completed in 15 days, possibly without the DPO conducting any sea time. This fact continues to be a great concern for the maritime industry, many of whom view a scheme with this timetable as a way for DPOs to "buy" their certificate (Hogue, 2012).

Second, the SMSC program is remarkable in the fact that it is the first DPO certification scheme containing a real final competency assessment. Specifically, the final assessment contains two parts, a 50 question theoretical assessment and a simulator-based practical assessment (Offshore Support Journal, 2013).

As designed by SMSC, the practical assessments is essentially a complete DPO approach operation, whereby the prospective DPO is given an operation, allowed 30 minutes to plan and prepare. As the operation progresses, emergency situations are thrown at the DPO to measure his or her ability to recognize and properly react to faults, failures, and emergency operations. While the simulators used in the assessments are sophisticated and capable of mimicking complex or emergency DP operations, they are limited in their ability to mimic the setup, or configuration of different vessels. Thus, many questions if simulator-based assessments are proof of competency or proof how well the DPO can use that particular simulator.

Finally, the SMSC scheme was the first scheme to recognize that the modern DP industry includes many different sub-industries and therefore includes specialized training. Level 3 of the SMSC program requires DPOs to complete one of four courses targeted to specific types of DP operations:

- Station-keeping: For those involved in the supply, standby, anchor handling, accommodation, and cruise vessel industries;
- Shuttle Tanker: For those involved in the shuttle tanker industry or those who utilize the weather vane and approach DP modes (or the equivalent modes depending upon DP manufacturer);
- Advanced Operations: For those involved in the ROV, diving, cable lay, pipe lay, and other industries involved with sub-surface operations; and
- Rig: For those involved in the drillship and MODU industries (Hogue, 2012)

Utilizing this certification scheme, SMSC certified its first DPOs in early March of 2013 (Offshore Support Journal, 2013).

There was good reason for the DNV and the SMSC to develop an industry specific and assessment-based DPO certification scheme at this time. Gone were the days of a DP club graduating 250 members per year. From 2011 to 2012 the worldwide fleet of DP vessels grew from approximately 2,800 vessels in 2011 to 3,200 in 2013, double the average previous growth rate. (The Nautical Institue, 2013). Additionally, the Nautical Institute was certifying more than 2,500 DPOs per year through almost 80 accredited training providers (The Nautical Institue, 2013). The utilization of DP had also changed significantly, with DP now being utilized on at least nine distinct types of vessels from MODUs to luxury yachts (The Nautical Institute, 2014).

Nautical Institute's Scheme Review:

In October of 2012, the Nautical Institute announced they were beginning the first top-to-bottom review of their certification scheme, specifically stating the review was necessitated by:

- OSV and shuttle tanker concerns about the sea time requirement,
- Requests to address DP time on drilling rigs for Posmoor mode,

- The need to review the entry requirements for the program,
- Competition from the DNV,
- The possibility of flag state certification of DPOs, and
- The need for a competency assessment system (The Nautical Institute, 2012)

To address these issues, the Nautical Institute set out seven action items for the scheme review:

- Setting competency requirements of a DPO, considering different ship types and operations;
- Develop training tasks to further the DPOs proficiency in the decided upon competencies;
- Develop requirements for training centers, their instructors, and training equipment;
- Define how much time should be devoted to each phase of training;
- Redevelop and further define the entry requirements for the scheme;
- Conduct a gap analysis on the items developed to address the previous bullet points and the current scheme; and
- Make recommendations regarding the revalidation of certificates (The Nautical Institute, 2012).

The review was announced on October 26, 2012 with a scheduled completion date of April 5, 2013 and an implementation date of January 1, 2014 (The Nautical Institute, 2012). However, the implementation date was later adjusted to January 1. 2015, as the Nautical Institute continued to seek input from the industry.

While the Nautical Institute's updated scheme addressed some of the identified issues, it did not result in the creation or publication of a specific basis for the certification scheme beyond successful completion of the courses and sea time. Similarly, the review resulted in theoretical assessments (multiple choice) being added to the Induction and Simulator Courses, but the Nautical Institute chose not to include a practical assessment of a DPO's abilities.

The Nautical Institute did, however, add a shuttle tanker-specific DPO certification. This new certificate included "shuttle tanker specific tasks as an amendment/supplement to . . . the Nautical Institute DP logbook," but is not based upon a defined set of competencies and lacks a final assessment of the prospective DPO. (The Nautical Institute, 2014). As the only new certificate offered, the scheme review essentially divided the DP industry into shuttle tanker DPOs and non-shuttle tanker DPOs.

2013 Revision to DNV 3.322:

In contrast to the Nautical Institute's lack of movement to address of the diversity of the industry, add a basis for their certificate, or require DPOs to pass a competency assessment, the DNV released an updated version of DNV 3.322 in 2013. As stated in the description of changes section in the document, "the 2009 version of [DNV 3.322] focused on general DP and station-keeping. The revised 2013 standard also captures the various DP-modes used for different activities" (Det Norske Veritas AS, 2013).

Specifically, the updated version of DNV 3.322 divides all DPO competencies into eight tables, two covering general DP operation and a table for six different DP specialties tables. Further, the guide breaks the DP industry into five different disciplines, and assigns each a notation code. Subsequently, the guide lists which tables are applicable to each discipline (see Table 3 and Table 4) (Det Norske Veritas AS, 2013).

Table 3: Division of DPO competencies into Tables as seen in DNV 3.322

Table Number*	DP modes covered by Table
Table 3-1	General competencies, applicable to all DP industries
Table 3-2	Applicable to auto positioning and joystick operations (station-keeping)
Table 3-3	Applicable to Approach Mode
Table 3-4	Applicable to Weather Vane mode
Table 3-5	Applicable to Follow Target mode
Table 3-6	Applicable to Auto Track mode
Table 3-7	Applicable to Submerged Turret modes
Table 3-8	Applicable to Position Mooring (Posmoor) modes

(Det Norske Veritas AS, 2013)

Table 4: Definitions of the Notation Codes Contained in DNV 3.322

Notation Code	Competent in the use of the following DP-systems	Examples of Operations	Applicable Competence Tables
AJ/S	Autopos, Joystick	Station keeping: Supply, Standby, Anchor handling, Cruise, Well service, Accommodation, Lifting operations, Construction, Diving	Table 3-1 – General Table 3-2 – Autopos/ Joystick
AJ/DPA-WV	Autopos, Joystick, DP-Approach mode, Weather vane	Offshore Loading: Shuttle tankers (SPM, OLS, Tandem, FSL, SAL, DSL)	Table 3-1 – General Table 3-2 – Autopos/ Joystick Table 3-3 – DP Approach Mode Table 3-4 –Weather Vane
AJ/FT-AT	Autopos, Joystick, Follow Target, Auto Track	ROV operations, Cable laying, Pipe laying, Trenching, Dredging, Rock dumping	Table 3-1 – General Table 3-2 – Autopos/ Joystick Table 3-5 – Follow Target Mode Table 3-6 – Auto Track Mode
AJ/DPA-STL	Autopos, Joystick, DP-Approach mode STL-Connect, STL-Loading	Submerged Turret Loading Operations	Table 3-1 – General Table 3-2 – Autopos/ Joystick Table 3-3 – DP Approach Mode Table 3-7 – STL
AJ/POS	Autopos, Joystick, anchorhandling, Posmoor, Drilling, Riser management	Drilling Rig, Production Rig: Use of DP while anchored and during drilling / production operations	Table 3-1 – General Table 3-2 – Autopos/ Joystick Table 3-8 – Position Mooring / ATA

(Det Norske Veritas AS, 2013)

Other Non-DPO Competency DP Guidance and Standards Released:

The DNV and SMSC were not the only entities recognizing that the previously described diversification of DP required a diversification of guidance, standards, and regulations. In fact, in 2006 IMCA published, IMCA M 182, *International Guidelines for the Safe Operation of Dynamically Positioned Offshore Supply Vessels* (Giddings, 2008). Subsequently, these guidelines were updated in 2009. IMCA states the reason for the publication—and continuous updating—of this guidance is:

> unlike most other DP vessel operations, a DP OSV operating in DP mode can usually in an instant be switched to joystick/manual mode and be moved away from the offshore installation without incurring injury, loss, or damage" (The International Marine Contractors Association, 2009).

Additionally, 2010 the Marine Technology Society's Dynamic Positioning Committee issued the first draft of *DP Operations Guidance*, Part 1 of which provides general guidance regarding the operation of DP-equipped vessels and Part 2 of which provides guidance specific to MODUs, project or construction vessels, and logistic vessels.

Summary of the Development of Evolution of DP training Guidance and Standards:

The 30-year history of DPO certification is one typified by three constants.

First, as the industry has progressed, the majority of the guidance and standards being issued reflect a recognition of the specialized nature and diversity of modern DP utilization. This can be seen in the updated version of IMCA M 117, in the STCW Code language, and certainly in the updated version of DNV 3.322. As the use of DP has proliferated across the maritime industry different subsections of his industry have developed very specialized uses of DP, thus, it stands to reason that DPOs should have a knowledge of general DP principles but then also a specialized competency in the field they operate.

Second, the history is marked with a drive for enhanced quality and consistency in the training and certification of DPOs. As the ranks of DPOs moved from a club of 250 DPOs all of whom essentially came from the same place to a worldwide DPO training industry, vessel owners, operators and charters wanted to ensure DPO's were competent.

Finally, the last 30 years have been marked by the Nautical Institute's certification scheme, which is relatively unchanged from what it was when it was first approved in 1984. The primary components of this scheme are still the accrual of sea time, taking of classes, and task book completion overseen by vessel Masters and other DPO's without guidance or assessment standards. The increased requirements of industry for increased DPO competency through individual standardized assessment of skill has largely gone unanswered.

An Alternative Competency Scheme:

The need for an alternative DPO training and certification scheme responsive to the rapidly changing and growing offshore service vessel industry was self-evident to many stake holders. Although a single DPO certification system remains the preferred option by most, many see this as an unrealistic possibility within the organizational confines of the various certification providers and users.

The Offshore Service Vessel Dynamic Positioning Authority (OSVDPA) was formed to evaluate these needs and develop solutions. Based on its initial review and communications with industry it was determined that an alternative scheme was warranted. One which sought to reflect the evolution of DP

guidance and standards by including competency-based and assessed training in both general DP utilization and the unique nature of our specific industry.

The OSVDPA's decision to base its certification system on a defined list of competencies, was based on the Authority's desire to improve the quality of training and guidance from the International Standards Organization's standard *Conformity assessment – General requirements for bodies operating certification of persons* (ISO/IEC 17024), which requires "a certification scheme shall contain [in pertinent part] the following elements: a) scope of certification; b) job and task description; [and] c) required competence" (International Standards Organization, 2012).

Additionally, the OSVDPA's scheme offers well-defined and structured assessments as a central component of its certification system. This feature is also a reflection of maritime and ISO guidance and standards. ISO/IEC 17024 requires bodies engaged in the certification of persons to include an assessment (ISO uses the term "examinations") within the certification scheme, "one of the characteristic functions of the certification body for persons is to conduct an examination, which uses objective criteria to measure competence" (International Standards Organization, 2012). Furthermore, Section 9.3.1 of ISO 17024 states:

> examinations shall be designed to assess competence based on, and consistent with, the scheme, by written, oral, practical, observational or other reliable and objective means. The design of the examination requirements shall ensure the comparability of results of each single examination, both in content and difficulty, including the validity of fail/pass decisions (International Standards Organization, 2012).

After reviewing the existing guidance and standards it was acknowledged that aspects from all of the existing guidance and standards documents would need to be incorporated to meet the competency requirements. Thus, it was determined that the OSVDPA had to develop its own competency standard to effectively integrate existing industry guidance with new competency assessment standards.

Table 5 represents the summary of a gap analysis utilized to review the applicability, strengths, and weakness of each of the existing guidance or standards. The results of this analysis were then reviewed to formulate our competency standard. As seen below, each document considered is listed in the table along with the justification for why the document was considered, the reason that document could not serve as the singular guide for the new scheme, and the points of emphasis from that document that were incorporated into the new competency table.

Table 5: Summary of the Gap Analysis of the Existing DPO Competency Guidance Documents

Guidance or Standard:	Reason Utilized:	Reasons could not be utilized as the OSVDPA standard	Points of Emphasis Taken:
STCW B-V/f	As IMO guidance must be addressed.	Lists only 8 items training should cover.	Importance of vessel-specific experience.
IMCA M 117	Foundational guidance for DPO competency. Section 6 provides	Section 6 is too broadly worded to be standalone scheme basis.	The importance of vessel-specific training. Manual maneuvering capabilities.

	itemized competency list for each DP-related position. Appendixes 2 and 4 provide "Course Objectives" for Induction and Simulator Course.		
IMCA M 182	As an OSV-specific guidance is tailored to the aim of the OSVDPA.	Does not include an explicit competency table.	Importance of risk assessing operations. Importance of manual ship handling. Importance of discerning, and monitoring drift on/off. Importance of operation and contingency planning. Proper selection and monitoring of separation distance,
The Nautical Institute's DPO Certification Scheme	Primary certifier of DPOs.	Does not have a single competency list. Its de facto lists for Phase 1, 2, and 3 contain overlaps and oversights. Places little emphasis on operating under manual control. Does not provide theoretical or practical training in use of MTS concepts, e.g. ASOGs, CAMO, and TAM.	The Phase One "Course Objectives" fully detail position reference systems and their common faults and failures. The task book contains well written expressions of competency.
MTS' DP Operations Guidance	Source for many commonly used DP concepts.	Does not include a competency table.	Properly recognizes the importance of the vessel's FMEA. ASOG risk assessment tool. CAM/TAM vessel configurations. Instructions for operations manual can be used as competency checklist.
MTS' MDAT	A review of what is expected of DPOs.	Does not include a competency table.	The causal factors of DP incidents (a guide to what training must emphasize). The seven attributes of a quality DP system concept. Cognitive level for each member

			of the crew for 11 elements of DP operations, including: commonly utilized concepts (the seven attributes, WCF, ASOG, and CAM/TAM); the vessel's FMEA and WCF; systems and subsystems (e.g. propulsion, PRS, sensors); modes; and missions.
DNV 3.322	The only comprehensive DP competency manual.	Each competency is broken down too far to be of practical use. (See Table 1 for an example). The division competencies does not line up with operation of DP OSVs (e.g. many OSV skills are found in the tables relating to shuttle tankers. Does not provide theoretical or practical training in use of MTS concepts, e.g. ASOGs, CAMO, and TAM.	The importance of manual control. Level of cognition is a useful guide for where within a certification scheme the DPO should master the competency. A single line item for every competency required of a DPO.

Utilization of the Guidance and Standards in the Creation of the OSVDPA Competency Table:

As seen in Table 5, the 30 years of guidance and standards regarding DPO competency provides a wealth of information that was utilized by the OSVDPA to construct an integrated competency standard.

First, the foundational documents were reviewed (STCW B-V/f and IMCA M 117) and OSVDPA ensured the Authority's competency table addressed all of the points raised therein (e.g. use of control stations, power generation and management, thrusters, position reference systems, etc.).

Second, the OSVDPA drafted competencies to address all relevant competencies in DNV 3.322 (generally, the majority of 3-1 and 3-2 and some of 3-3, 3-5, and 3-6) and the Course Objectives listed for the Nautical Institute's Introduction and Advanced Course, and taskbook.

Third, the OSVDPA drafted competencies to address the areas of emphasis and themes from the other guidance documents listed above.

Through this process the OSVDPA feels it has addressed the not only the universal basics of DP but also the themes particular to the DP equipped offshore service vessels. One such theme was the importance of risk assessment and operation planning. The MTS Operations Guidance highlights the importance of these concepts (The Marine Technology Society's Dynamic Positioning Committee, 2012). Similar guidance is provided in DNV 3.322, which includes 13 unique competencies for operation planning (Det Norske Veritas AS, 2013) and IMCA M 182, which includes an entire section on the importance of risk assessing DP operations conducted by OSVs (The International Marine Contractors Association, 2009). As a result of this guidance, as well as the OSVDPA member's experience, Section 19 "Operation

Planning and Risk Assessing" in our competency manual (Table 6.) will be integrated into the OSVDPA scheme. This section includes 25 facets of operation planning and risk assessing that DPOs should be instructed upon.

The integration of ASOGs provides another example of how existing guidance was identified and integrated to produce our own competency manual. As stated in Table 5, the existing DPO competency guides do not recommend or require theoretical or practical training in the use of ASOGs. However, as detailed in the MTS Operations Guidance, and MTS' MDAT use of these decision support tools have been proven to greatly decrease DP incidents.

> Systematic implementation of the guidance resulting in the development and use of the WSOG/ASOG has succeeded in reducing loss of position incidents. Investigation of the loss of position incidents where effective ASOGs were in place revealed that failure to follow the ASOG was the key and at times the sole contributing factor (The Marine Technology Society's Dynamic Positioning Committee, 2012).

Considering this importance, 14 competencies which require DPOs to have a theoretical knowledge of or practical ability to use an ASOG were integrated into the scheme.

Another example of the integration of skill sets to improve competency is the OSVDPA's emphasis on the DPO's ability to operate the vessel in manual control as well as DP; an importance facet of DP control on an OSV because, "unlike most other DP vessel operations. OSVs can, under normal operating circumstances: terminate supply operations and move away from the offshore installation at a moment's notice and /or can be safely maneuvered in joystick/manual control while supply operations are being carried out" (The International Marine Contractors Association, 2009). 12 manual control competencies have been included in the new scheme that must be proven by DPOs before they can be certified as competent DPOs.

OSVDPA's Draft Competency Table:

The below table represents the current draft of the OSVDPA competency requirements for DPOs. This draft has been created by the Authority's Technical Advisory Council (TAC). The TAC is charged with making recommendations to the Board of Directors on all matters dealing with the crafting, implementation, and execution of the certification program. As the

TAC members are selected by the Board of Directors and serve continuous terms. In addition to the current 13 regular members, the TAC has three observer members. The observers are provided access to the meetings, communications, and deliberations of the TAC to provide input and advice from other industries or organizations interested in dynamic positioning technology. The TAC seeks the input of the larger maritime community before submitting this table to the OSVDPA Board of Directors for final approval.

Within this table, each competency is listed as a practical or theoretical competency. Practical competencies are assed in onboard or simulator-based assessments, while theoretical competencies are assessed via multiple choice exams.

Table 6: Draft Competency table for the OSVDPA

Item No.	Competency or Section
Sec. 1	Alarms
1.1	Describe which alarms are critical to the current operation (Practical).
1.2	Recognize and acknowledge alarms and convey information about the alarms to relevant crew members and other parties (Practical).
1.3	Demonstrate the setting of alarms relevant to the DP system (Practical).
1.4	Describe the procedures for setting warnings and alarms, including selecting acceptable limits and recognizing factors that decrease acceptable alarm limits (Theoretical).
Sec. 2	Bridge Team
2.1	Describe a formal hand-over and the importance of clearly relating and understand all relevant factors (Theoretical).
2.2	Describe the organization of the bridge team on your vessel when the vessel is under DP, including the authority, tasks, and responsibilities of each member of the bridge team (Theoretical).
2.3	Demonstrate a clear and formal hand-over of the DP watch, including the preparation of a hand-over checklist and clearly communicating the vessel status, DP-details, ongoing/planned operations, and other recent occurrences that affect the DP operations (Practical).
2.4	Demonstrate a review and verification of hand-over checklist and all relevant information, including: vessel's position, movement and status; recent occurrences; weather changes; and DP log (Practical).
2.5	Demonstrate proper execution of a DP watch as part of a bridge team (if utilized) (Practical).
2.6	Demonstrate proper response to a DP incident or emergency as part of a bridge team (Practical).
Sec. 3	Capability and Footprint Plots
3.1	Describe how a capability plot is produced, how it is interpreted, its usefulness to DP operations, and its limitations (Theoretical)
3.2	Explain the function of a footprint plot and the environmental or operational characteristics affecting its shape (Theoretical)
3.3	Assess the vessel's station keeping capabilities against the vessel's capability plot and interpret this information (Practical)
3.4	Utilize the vessel's capability plot in the planning of an operation (Practical).
3.5	Demonstrate the generation of a DP footprint plot using the DP system or paper charts (Practical)
3.6	Describe the difference between capability plots and footprint plots and the correlation between the two (Theoretical).
Sec. 4	Checklists
4.1	Describe the checklists that must be completed under applicable (e.g. IMCA, MTS, Class, customer, etc.) guidance and their importance (Theoretical).
4.2	Demonstrate completion of the location (field arrival), pre-operation (500 meter), and any other required checklist (Practical).

Sec. 5	Commands and Use of the DP Desk
5.1	Demonstrate the input of commands into the DP system using a variety of input methods (Practical):
5.1.1	Position commands,
5.1.2	Heading commands.
5.2	Describe how to use the gain settings, when different gain settings should be utilized, and when settings should be adjusted (Theoretical).
5.3	Demonstrate a knowledge of the layout of the DP desk, noting where controls and status information is contained and relation to other maneuvering controls (Practical).
5.4	Demonstrate the ability to set up and verify the various operator controls of the DP system (Practical).
5.5	Demonstrate the proper use of the gain settings, including the setting and adjusting of gain settings (Practical).
5.6	Demonstrate procedure to verify DP system is correctly responding/ following commands and the procedures to follow when system fails to respond to commands (Practical).

Sec. 6	Communication
6.1	Describe the importance and methods of keeping crew, engine room personnel, equipment operators, the installation, and other relevant entities informed of operational details (Theoretical).
6.2	Describe which crew members should be kept apprised of relevant operational information (Theoretical).
6.3	Demonstrate clear communication (via all relevant methods) of relevant operational details (including changes in status) with relevant crew, onboard and project personnel, the installation, and third parties (including SIMOPS vessels) (Practical).

Sec. 7	Conditions, Environment, and Weather
7.1	Describe the effects of environmental conditions on vessel performance (Theoretical).
7.2	Describe the importance of environmental condition monitoring and instances and operations where condition monitoring is of critical importance (Theoretical).
7.3	Interpret weather forecast and determine if conditions are projected to be inside of the vessel's DP operation envelop (Practical).
7.4	Evaluate changes in environmental conditions to determine if operations can be continued (Practical).

Sec. 8	Consequence Analysis
8.1	Describe the importance and proper use of the Consequence Analysis function (if fitted) (theoretical).
8.2	Describe what conditions the Consequence Analysis function on your vessel is monitoring (if fitted) (Practical).
8.3	Demonstrate the correct use of the Consequence Analysis function including the setting of software and proper response to its alarm (if fitted) (Practical).

Sec. 9	Control Systems and Computer
9.1	Describe the proper procedures for powering up and shutting down the DP system and DP controller (Theoretical).
9.2	Demonstrate the proper procedures for powering up and shutting down the DP system and DP controller (Practical).
9.3	Demonstrate switching between DP computer and control systems (Practical).
9.4	Describe the effect of resetting the DP computer and the DP controller, why the effect of resetting the computer and controller are different, and when not to reset the DP computer and DP controller (Theoretical).
9.5	Demonstrate resetting of all DP computers (OS stations, controllers, and backups) while remaining in control of vessel (Practical).
9.6	Demonstrate the different ways of resetting the DP computer and controller and a transfer of control all available systems, without losing control of the vessel, and describe the advantages and disadvantages of each way. (Practical).

Sec. 10	DP Control Modes
10.1	Describe each of the below-listed control modes (or the equivalent mode depending upon equipment used), when each mode would be used, and the benefits and drawbacks of each mode (Theoretical):
10.1.1	Auto Position,
10.1.2	Auto Heading,
10.1.3	Auto Pilot,
10.1.4	Follow Target,
10.1.5	Joystick,
10.1.6	Independent Joystick,
10.1.7	Track Follow,
10.1.8	Weathervane,
10.1.9	Mixed Mode,
10.2	Understand and describe the setup of the DP control elements (e.g. controlling the axes of freedom), modes of operation, and the limitations associated with each mode (Theoretical).
10.3	Describe the difference between a DP joystick and an independent joystick and the benefits and limitations of each joystick (Theoretical).
10.4	Demonstrate the ability to use each control mode (e.g. Autopos, Autopilot, Joystick, mixed mode) (Practical).
10.5	Demonstrate the ability to select, enter necessary parameters, and switch between the various operating modes of the DP system (Practical).
10.6	Demonstrate use of the independent joystick to maintain/change position/heading (Practical).

Sec. 11	Manual Control
11.1	Describe advantages/disadvantages of operating in manual mode including references to the various types of propulsion systems (Theoretical)
11.2	Describe why the vessel should be brought to a full stop prior to switching into DP mode (Theoretical).

11.3	Describe the hierarchical steps and procedures for switching from manual mode to DP (Theoretical).
11.4	Describe if manual control should or should not be selected after a blackout based on the specifics of your vessel (Theoretical).
11.5	Demonstrate bringing the vessel to a full stop at a safe distance from all objects in manual mode (Practical).
11.6	Demonstrate holding position and maneuvering in manual mode under various weather conditions (Practical)
11.7	Describe the vessel specific procedure for switching to manual mode to deal with a DP system failure or emergency (Theoretical).
11.8	Demonstrate competency in ship handling abilities, including stopping, station-keeping, and maneuvering the vessel in close quarter situations under various environmental conditions (Practical).
11.8.1	Demonstrate handing of the vessel after the WCF for your vessel (Practical).
11.9	Demonstrate the ability to change from DP to manual control (Practical):
11.9.1	Under a normal operating condition,
11.9.2	Under an emergency condition.

Sec. 12	DP System General
12.1	Demonstrate an understanding of DP systems and subsystems and their relationship with all involved units, their functions, and power supplies (Theoretical).
12.1.1	Draw a diagram of a generic DP system.
12.1.2	Draw a diagram of your vessel's DP system.
12.2	Describe the various components that comprise a DP system, including: position and environmental references; computer controller and display; propulsion and steering systems, power plant and power distribution (Theoretical).
12.3	Describe the purpose of the model and how it is utilized. In doing so, explain the quick model/fast learn function and when it should be used and how long model building takes in both modes and the system's limitations during this time (Theoretical).
12.4	Use onboard documents to locate and describe the various vessel specific components that comprise the DP system, their function, and interaction (including how they relate to the vessel's redundancy concept) (Practical).
12.5	Describe what equipment is critical, the failure of which will affect vessel position and/or heading (Theoretical).
12.6	Describe identified Worst Case Failure and describe the vessel's design intended capabilities after WCF and where onboard the vessel this information can be found (Theoretical).

Sec. 13	Drift/Drive On and Drift/Drive Off
13.1	Describe drift/drive on and drift/drive off, the differences, risks, and factors leading to each (Theoretical).
13.2	Describe actions to be taken in drift/drive on and drift/drive off scenarios (Theoretical).
13.3	Demonstrate actions to be taken in drift/drive on and drift/drive off scenarios (Practical).

Sec. 14	Drills and Training
14.1	Describe the importance of DP-based drills and the specific vessel's drill schedule (Theoretical).
14.2	Demonstrate proper use of the on-board training/simulation function (if fitted) (Practical)
14.3	Demonstrate participation in a documented DP drill (Practical)

Sec. 15	Emergency Procedures
15.1	Describe the situations (e.g. DP system degradation or change in conditions) that are mostly likely indicate an impending emergency and what measures can correct the situation (Theoretical).
15.2	Describe the proper sequence of actions to respond to a DP system emergency (Theoretical).
15.3	Describe the use of an ASOG, CAMO, or TAM in an emergency situation and how these documents guide the operator (Theoretical).
15.4	Demonstrate the ability to recognize an emergency, and the possible necessity of taking manual control of the vessel (Practical).
15.5	Demonstrate the proper evaluation steps and potential actions (up to and including DPO intervention) to the following situations (Practical).
15.5.1	A sudden and significant change in reference system data, unstable PRS, or sensor input error.
15.5.2	The loss of a PRS.
15.5.3	A drift off, drive off, force off, and thruster run off.
15.5.4	The loss of the DP system.
15.5.5	Instability, emergency, or loss of generator/power system, computer system, commands, feedbacks, inputs, or other components impacting the DP system.
15.5.6	The vessel exceeding a pre-defined alarm limit.

Sec. 16	Failure Mode Effect Analysis (FMEA) and Annual Trials
16.1	Based on IMCA M 166, IMCA M 190, MTS' DP Vessel Design Philosophy Guidelines, and other relevant current guidance, describe a Failure Mode Effect Analysis (FMEA) (Theoretical).
16.1.1	The FMEA's purpose and value to operations.
16.1.2	How a FMEA is proven.
16.1.3	The process and schedule of FMEA revalidation.
16.1.4	The procedures carried out during annual trials and what information the DPO can glean from the trials.
16.2	Describe how the vessel's FMEA correlates to the vessel's redundancy concept, ASOG, CAMO, and other operational procedures (Theoretical).
16.3	Demonstrate an ability to read an annual trial and describe what corrective procedures are required (Practical)
16.4	Demonstrate an application of the vessel's FMEA to the planning and execution of an operation, including contingency planning, emergency response, and creation of CAMO within the capabilities of the vessel after worst case failure (Practical).

Sec. 17	Class, Standards, Guidance, Manuals, and Logs
17.1	Describe the general concepts and specific requirements of each DP class as defined by IMO MSC 645 (Theoretical).
17.2	Describe the importance of keeping a vessel DP logbook and what information should be recorded in the logbook (Theoretical).
17.3	Demonstrate verification that the vessel is set up to class standards (Practical).
17.4	Demonstrate locating the DP related documentation onboard and explain their relevance to specific vessel operations (Theoretical).
17.5	Describe the publications or sources of the current rules, standards, guidelines, and recommendations affecting DP operations; each document's relevance, and which of these documents are normally kept on the vessel (Theoretical).
17.6	Demonstrate knowledge and proper understanding of operational instructions (e.g. operations manuals, industry guidance/standards, client procedures, bridging documents, etc.).
17.7	Determine if the vessel continues to operate to DP class requirements after the loss of a system or component (Practical).

Sec. 18	Incident Reporting and Investigation
18.1	Describe the importance of reporting DP events, which events should be reported, the company procedure for reporting DP events, and the IMCA reporting system (Theoretical).
18.2	Demonstrate an ability to read a DP incident report and detail identify actions (if any) the DPO could have done to avert incident (Practical).

Sec. 19	Operation Planning and Risk Assessing
19.1	Describe the importance of properly planning a DP operation and the elements that should be considered when planning an operation. (Theoretical).
19.1.1	Describe ASOG, the process used to create an ASOG, how it is used, and its limitations.
19.1.2	Describe CAMO and TAM, the differences between each mode, why each mode would be selected, and how (and how not) a vessel enters TAM.
19.1.3	Describe external factors that will influence, complicate, or require abandoning of a DP operation.
19.1.4	Describe additional precautions that should be taken when the vessel is positioned on the drift on side of the installation.
19.1.5	Describe the process used to determine a safe working position and heading and safe standby position, taking into consideration all of the factors necessary to make these determinations.
19.1.6	Describe the process used to create a DP approach plan, work plan, and plan to exit the field.
19.1.7	Describe what factors should be considered when selecting which reference systems should be used for an operation and the limitations carried by each system.
19.2	Describe the risk assessment processes and procedures and their importance (Theoretical):
19.2.1	A formal risk assessment,
19.2.2	A safe job analysis,

19.2.3	Tool box talk,
19.2.4	A contingency plan and ensuring the plan remains valid throughout the operation,
19.2.5	Continuous risk assessment throughout an operation.
19.3	Determine a safe location to complete arrival checklists, considering conditions and movement of other vessels and obstructions (Practical).
19.4	Demonstrate the ability to conduct a formal risk assessment, safe job analysis, and tool box talk or interpret the results of a risk assessment, safe job analysis, or tool box talk prior to the start of an operation (Theoretical).
19.5	Demonstrate use of the vessel's ASOG and capability plot to determine if DP operations are possible (Practical).
19.6	Conduct an environmental force evaluation (Practical).
19.7	Demonstrate selection of the proper reference systems for an operation, the ability to evaluate the consequences of losing a particular reference system, and external influences that may interfere with references systems (Practical).
19.8	Demonstrate setting excursion limits based upon company/client procedures, job requirements, or the vessel's ASOG (Practical).
19.9	Demonstrate the creation of a DP approach plan, work plan, and plan to exit the field (Practical).
19.10	Utilizing the vessel's ASOG, and/or operating mode (i.e. CAMO or TAM), and class requirements, demonstrate proper set up of the generator and bus ties for a particular operation (Practical).
19.11	Demonstrate the ability to determine a safe working position and heading based on conditions, charterer requirements, and international or regional regulations or guidelines (Practical).
19.12	Demonstrate the development of a contingency plan and the ability to plan a new escape path during the operation based upon changes in conditions, other vessels, or changes in the operation (Practical).
19.13	Demonstrate the ability to conduct a continuous risk assessment of an operation, react appropriately to any alarms, and make necessary changes to the operation (Practical).

Sec. 20	Operation (Set Up and Approach)
20.1	Describe the procedures for approaching an installation, including (Theoretical):
20.1.1	Transferring from manual to DP,
20.1.2	Setting of proper steps,
20.1.3	Speed selection,
20.1.4	Stopping the vessel in a safe manner at the proper position and with the proper heading.
20.2	Describe the process of setting up the vessel on DP and ensuring all DP systems and subsystems are operational (Theoretical).
20.3	Describe what factors the DPO should monitor during an approach to an installation, (e.g. changes in conditions, other vessels, changes in installations) and how these factors can affect the approach and contingency plan (Theoretical).
20.4	Describe how to conduct, the purpose of, and limitations of a drift test (Theoretical)
20.5	Demonstrate proper set up and verification of the thrusters for an operation, taking into consideration the environmental conditions, exclusion zones, and efficiency of the power plant (Practical).

20.6	Assess of the vessel against the capability plot (if fitted) and interpret the results (Practical).
20.7	Demonstrate setting up the correct reference systems and sensors for the operation and verifying they are operating correctly (Practical).
20.8	Demonstrate how to set up and conduct a drift test (Practical).
20.9	Utilizing company/client procedures and/or the vessel's ASOG, demonstrate stopping and stabilizing the vessel in a controlled manner in a safe position; switching from manual control, to joystick, to full DP; then beginning the approach to the worksite (Practical).
20.10	Utilizing company/client procedures and/or the vessel's ASOG, demonstrate proper selection of speed and steps to approach an installation (Practical).
20.11	Demonstrate proper anticipation and reaction to changes in operational or environmental conditions during the approach (Practical).

Sec. 21	Operation (Normal Execution)
21.1	Describe the items a DPO should be aware of during a DP operation (Theoretical).
21.2	Describe center of rotation, how the DPO selects the center of rotation and why selecting the proper center of rotation is important (Theoretical).
21.3	Describe factors such as deployed equipment or divers in the water that may limit a vessel's performance or ability (Theoretical).
21.4	Describe how changes in the installations heading and position can affect a DP operation (Theoretical).
21.5	Describe the need to anticipate changes in the operation and make changes when necessary (Theoretical).
21.6	Describe the process of selecting an additional PRS (Theoretical).
21.7	Describe how to use an ASOG to determine if continued operations are possible (Theoretical).
21.8	Describe the reaction from thrusters to a significant and sudden change in sensor input and the appropriate reaction from the DPO (Theoretical).
21.9	Describe the concept of time to terminate and why knowledge of this information is important to the operation (Theoretical).
21.10	Demonstrate continued situational awareness of the vessel's heading, position, and status during a DP watch (Practical).
21.11	Demonstrate continued awareness of the installation's heading and position and anticipate and reacting to situations that may arise from a change an installation's heading or position (Practical).
21.12	Demonstrate monitoring the DP system, anticipating problems and making corrections as needed (Practical).
21.13	Demonstrate an ability to analyze the consequences of a loss of position and react accordingly (Practical).
21.14	Demonstrate monitoring of environmental conditions (Practical).
21.15	Demonstrate monitoring of PRS and vessel sensors, including monitoring signal quality, accuracy, and anticipating and reacting to problems (Practical).
21.16	Demonstrate the process of checking and monitoring the functionality of the DP system and sub-systems and determining if continued operations are possible (Practical).
21.17	Demonstrate planning of a new escape route during the course of an operation (Practical).
21.18	Demonstrate changing of position by inputting proper speed and steps (Practical).

21.19	Demonstrate an awareness of vessel position, monitor vessel excursions, and determine if excursions exceed safe working conditions, based on company/client procedures and/or vessel's ASOG (Practical).
21.20	Demonstrate an evaluation of environmental conditions and vessel status against the vessel's ASOG to determine if continued operations are possible (Practical).
21.21	Demonstrate monitoring of the percentage of available power in use and in reserve and determining if continued operations are possible. (Practical).
21.22	Demonstrate monitoring of the vessel's thrusters and making changes to adapt to changing environmental conditions or to maximize efficiency of the power plant (Practical).

Sec. 22	Operation (Degraded Status)
22.1	Describe actions to take in case of either a degraded status or complete DP system failure (Theoretical).
22.2	Describe degraded status, vessel capabilities, additional risks (Theoretical).
22.3	Describe the difference between a degraded status and TAM and how each mode is entered (Theoretical).
22.4	Demonstrate the ability to take corrective action in case of a degraded status or DP system failure (Practical).
22.5	Demonstrate the ability to safely maneuver and stabilize the vessel with degraded thruster/ power capacity (after identified WCF) (Practical).
22.6	Demonstrate the reaction to an unstable PRS, the loss of a PRS, or when a PRS suddenly indicates a significant change in position (Practical).
22.7	Demonstrate the response to a malfunctioning or inaccurate vessel sensor (Practical).
22.8	Demonstrate the ability to use an ASOG (or other operational guideline) to determine the vessel's status and if an operation needs to be discontinued or if continued operation needs to be risk assessed (Practical).

Sec. 23	Operation (Emergency Abandoning) DP abort status
23.1	Describe the possible reasons a DP operation would need to be abandoned under a short time to terminate (Theoretical).
23.2	Describe the vessel specific procedures for abandoning of DP operations (Theoretical)
23.3	Demonstrate the procedures for abandoning of the operation. (Practical)
23.4	Demonstrate utilizing the vessel's ASOG, CAMO, capability plot, or other operation guideline to determine if DP operations must be abandoned (Practical).
23.5	Demonstrate safety navigating away from the installation after an emergency (Practical).

Sec. 24	Operation (Normal Completion)
24.1	Describe the need to move the vessel to a minimum safe location prior to changing control modes (Theoretical).
24.2	Describe the field departure procedures and what hazards can be encountered during these procedures (Theoretical).
24.3	Describe the importance of revalidating the departure plan and cargo transfer termination plan at the end of the operation (Theoretical).

24.4	Demonstrate moving vessel out to a safe location on DP prior to switching to manual control (Practical).
24.5	Demonstrate maneuvering the vessel to the identified safe position in a controlled manner and with the proper steps (Practical).
24.6	Demonstrate the process of disconnecting any hoses, recovering deployed equipment of the vessel, divers, or sensors (Practical).

Sec. 25	Reference Systems, Sensors, and Related Equipment
25.1	Describe the working principle behind and role within the DP system of each of the following (Theoretical):
25.1.1	Environmental reference system,
25.1.2	Position reference system,
25.1.3	Heading sensor,
25.1.4	Motion Reference Unit,
25.1.5	Vertical Reference Unit.
25.2	Describe the working principle behind, benefits, limitations, external influences, and common faults of the following (Theoretical):
25.2.1	Laser-based systems,
25.2.2	Microwave-based systems (FMCW Radar),
25.2.3	GNSS,
25.2.4	Relative GPS (DARPS),
25.2.5	Acoustic systems,
25.2.6	Taut Wire,
25.2.7	Other PRS.
25.3	Describe how PRS are utilized by the model (or not utilized by the model), including the weighting of reference systems in the model and differences between the model and current conditions (Theoretical).
25.4	Describe the importance of and how to conduct proper PRS selection, validating, and prioritization (Theoretical).
25.5	Describe the possible results of the loss of a PRS (Theoretical).
25.6	Describe the possible sources of disruption to wind sensors (e.g. helicopter operations).
25.7	Demonstrate the proper use of the following (Practical):
25.7.1	Environmental reference system,
25.7.2	Position reference system,
25.7.3	Heading sensor,
25.7.4	Motion Reference Unit,
25.7.5	Vertical Reference Unit.
25.8	Demonstrate the proper use, calibration, and testing of the following: (Practical).
25.8.1	Laser-based systems,
25.8.2	Microwave-based systems (FMCW Radar),
25.8.3	GNSS,
25.8.4	Relative GPS,
25.8.5	Acoustic systems,
25.8.6	Taut Wire,

25.8.7	Other PRS,
25.9	Demonstrate proper PRS selection, validation, and prioritization (Practical).
25.10	Demonstrate the proper set up (and clean-up after the operation, if applicable) of the PRS, VRU, environment, MRU, and heading sensors, equipped on the vessel (Practical).
25.11	Demonstrate where information about a predicted degradation of an external reference system (e.g. GNSS) can be found (if fitted) (Practical).
25.12	Demonstrate selection of the proper wind sensor based on operation, location, external influences (Practical).

Sec. 26	Power Generation and Marine Auxiliaries
26.1	Describe the main power generation elements in a diesel electric DP vessel, including main engines, governors and alternators and how redundancy is achieved on DP Class 2 and 3 vessels (Theoretical).
26.2	Describe the main power generation elements in a direct drive diesel engine DP vessel, including gearing and clutch mechanisms and how redundancy is achieved on DP Class 2 and 3 vessels (Theoretical).
26.3	Describe the marine auxiliary systems that support power generating plant, including fuel oil, lube oil, cooling water systems and compressed air and how redundancy is achieved on DP Class 2 and 3 vessels (Theoretical).
26.4	Describe the role of the emergency generator and its relevance to the DP system (Theoretical).

Sec. 27	Power Distribution
27.1	Describe the essential elements of power distribution in a diesel electric DP vessel, including switchboards, bus-ties, high, medium and low voltage systems and transformers (Theoretical).
27.2	Describe the different features of open and close bus-ties and different power distribution configurations and their impact on redundancy (Theoretical).
27.3	Describe battery back-up systems and UPS and their importance to the DP system (Theoretical).
27.4	Describe the procedures, the role of the DPO, and proper sequence undertaken after a full or partial blackout (Theoretical).
27.5	Describe the different switchboard and bus-tie configurations that are relevant to CAMO and TAM (Theoretical).
27.6	Demonstrate how to set up the power distribution system to achieve CAMO and TAM (Practical).
27.7	Describe how your vessel's power distribution arrangement furthers your vessel's redundancy concept (Theoretical).
27.8	Demonstrate the procedures and proper sequence undertaken by a DPO after a full or partial blackout (Practical).

Sec. 28	Power Usage and Power Management
28.1	Describe available power and spinning reserve and how to monitor both (Theoretical).
28.2	Describe the potential impact of non DP related consumers on power available to the DP system and the means of limiting the power consumed by them (Theoretical).
28.3	Describe the impact of heading and position on thruster usage and how to determine a working position to maximize thruster efficiency (Theoretical).

28.4	Describe the relationship between power usage and the vessel's ASOG (Theoretical).
28.5	Demonstrate proper monitoring of power output and percentage of power in use (Practical).
28.6	Demonstrate an awareness of the percentage of power it is taking to maintain position (Practical).
28.7	Demonstrate the selection of a working position which maximizes thruster efficiency (Practical).
28.8	Demonstrate competency as DPO in monitoring DP operating parameters IAW CAMO, TAM and ASOG to ensure continuous operating power is not exceeded. Identify and implement corrective actions based on observations (Practical).

Sec. 29	Principles of DP
29.1	Define the term "dynamic positioning" (Theoretical).
29.2	Describe the six degrees of freedom, the vessel motions associated with the six degrees, the external forces that impact these motions, and the vessel components that measure and/or counter these motions (Theoretical).

Sec. 30	Thrusters
30.1	Describe the different types of thrusters used in the DP system and the role of thrusters in the DP system (Theoretical).
30.2	Describe the thruster related items that a DPO should monitor and why they are important (Theoretical).
30.3	Describe the various failure modes of the different types of thrusters (Practical).
30.4	Describe thruster bias and its importance to DP operations (Theoretical).
30.5	Describe the configuration of the thrusters on your vessel (Theoretical).
30.6	Demonstrate identification of the various failure modes for all of the thrusters on your vessel (Practical).
30.7	Demonstrate proper setup of a thruster exclusion zone (Practical).
30.8	Demonstrate the proper thruster selection for conditions and nature of operation (Practical).
30.9	Demonstrate selection of a working position that optimizes efficient thruster usage (Practical).
30.10	Demonstrate the monitoring of thrusters, the ability to modify thruster set up to adapt to changes in conditions or new operational requirements (Practical).
30.11	Demonstrate the proper response to a thrusters malfunction, e.g. thruster run-off, loss of a thruster (Practical).

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