



Australian Government

MARH027 Apply knowledge of dynamic positioning systems

Release: 1

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Modification History

Release 1. This is the first release of this unit of competency in the MAR Maritime Training Package.

Application

This unit involves the skills and knowledge required to apply knowledge of dynamic positioning systems, including its uses and applications.

This unit includes explaining dynamic positioning control systems, applying environmental and position reference systems. It also includes explaining:

- acoustic systems
- differential global navigation satellite system (DGNSS)
- frequency-modulated continuous wave (FMCW) radar-based systems
- inertial navigation systems (INS)
- laser systems
- taut wire systems.

This unit applies to people working in the maritime industry in the capacity of:

- Dynamic Positioning Operator.

Work is performed under limited supervision and applies to those responsible for operating dynamic positioning control systems in the work environment and who are responsible for their own work.

Before undertaking this unit, seafarers will need to hold or be working towards the achievement of one of the following:

- Chief engineer officers and second engineer officers on ships powered by main propulsion machinery of 3,000 kW propulsion power or more
- Chief engineer officers and second engineer officers on ships powered by main propulsion machinery of between 750 kW and 3,000 kW propulsion power
- Electro-technical officer
- Master or chief mate on ships of 3,000 Gross Tonnage (GT) or more
- Officers in charge of a navigation watch on ships of 500 GT or more
- Officers in charge of a navigational watch and Masters on ships of less than 500 GT
- Officers in charge of an engineering watch in a manned engine room or designated duty engineers in a periodically unmanned engine room.

Licensing/Regulatory Information

No licensing, legislative or certification requirements apply to this unit at the time of publication.

Pre-requisite Unit

MARH025 Apply knowledge of dynamic positioning fundamentals

Competency Field

H - Navigation

Unit Sector

Maritime Sector

Elements and Performance Criteria

ELEMENTS	PERFORMANCE CRITERIA
Elements describe the essential outcomes.	Performance criteria describe the performance needed to demonstrate achievement of the element.
1 Explain dynamic positioning control systems	1.1 Architecture of a typical dynamic positioning control systems is described
	1.2 Function and components of dynamic positioning control systems are identified and explained
	1.3 Achieving redundancy using International Maritime Organization (IMO) requirements and vessel failure modes and effects analysis (FMEA) is described
2 Apply environmental reference systems	2.1 Function of gyro compasses and their redundancy in a dynamic positioning operating system is described
	2.2 Process for obtaining pitch, roll and heaving information to input into dynamic positioning system is described
	2.3 Rationale for inputting pitch, roll and heave into dynamic positioning system is explained
	2.4 Provision of wind sensors in a dynamic positioning system is described
	2.5 Wind feed-forward facility and its importance within the dynamic positioning system is described

- 2.6 Limitations of wind sensor inputs, rationale for deselection and consequences of deselecting wind sensor inputs are described
 - 2.7 Method by which the dynamic positioning system determines the value for dynamic positioning current/sea force and the residual error is described
 - 2.8 Reasons for the discrepancy between the displayed value of dynamic positioning current/sea force and the true current or tidal stream value are explained
 - 2.9 External reference systems are determined
- 3 Apply position referencing systems**
 - 3.1 Position reference systems used in dynamic positioning installations are outlined
 - 3.2 Principles of position referencing systems used in dynamic positioning installations are described
- 4 Explain DGNSS systems**
 - 4.1 Principles of DGNSS are described
 - 4.2 Operational of typical commercial DGNSS network using corrections which are delivered by satellite communications are outlined
 - 4.3 Effects on the quality of positioning impacted by error and inaccuracy associated with the DGNSS are described
 - 4.4 Quality data from DGNSS are identified and described
 - 4.5 DGNSS and other position referencing systems are compared and advantages and limitations are identified
- 5 Explain laser systems**
 - 5.1 Principles of position referencing using laser-based systems are described
 - 5.2 Method of setting up a laser system to provide best position information is outlined
 - 5.3 Advantages and limitations of laser-based position referencing systems are outlined
- 6 Explain FMCW radar-based systems**
 - 6.1 Principles of position referencing using FMCW radar-based systems are described
 - 6.2 Advantages and limitations of FMCW radar-based systems are outlined

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| | 6.3 | Principles and operation of Artemis position referencing system are described |
| | 6.4 | Operational advantages and limitations of Artemis position referencing system are outlined |
| 7 Explain acoustic systems | 7.1 | Operation of hydro-acoustic position referencing systems is described |
| | 7.2 | Principles of position-fixing using underwater acoustic systems working in super-short baseline (SSBL)/ultra-short baseline (USBL) and long baseline (LBL) modes are described |
| | 7.3 | Hydro-acoustic transponders, responders and pinger/beacon are described |
| | 7.4 | Layout of hydro-acoustic system, operator station, transceiver, transducer pole and transducer is described |
| | 7.5 | Operational advantages and limitations of acoustic systems as a position reference for dynamic positioning are outlined |
| 8 Explain taut wire systems | 8.1 | Principles of taut wire systems are described |
| | 8.2 | Types of taut wire position referencing systems are outlined |
| | 8.3 | Advantages and limitations of taut wire position referencing systems are outlined |
| | 8.4 | Display of taut wire reference data in dynamic positioning systems are described |
| 9 Explain INS systems | 9.1 | Principles of INS are outlined |
| | 9.2 | Method of using INS enhance existing position referencing system performance is described |
| | 9.3 | Other position referencing systems that can be used in conjunction with a dynamic position system is described |

Foundation Skills

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

Range of Conditions

Range is restricted to essential operating conditions and any other variables essential to the work environment.

Non-essential conditions may be found in the MAR Maritime Training Package Companion Volume Implementation Guide.

Unit Mapping Information

This is a new unit. No equivalent unit.

Links

Companion Volume Implementation Guides are found in VETNet -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=772efb7b-4cce-47fe-9bbd-ee3b1d1eb4c2>

Assessment Requirements for MARH027 Apply knowledge of dynamic positioning systems

Modification History

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Performance Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements and performance criteria on at least one occasion and include:

- describing operational advantages and disadvantages of Artemis position referencing system and acoustic systems for dynamic positioning
- describing the architecture of a typical dynamic positioning control system
- describing the different principles of position referencing systems and how they are used in dynamic positioning installations
- describing the reasons for discrepancy between the displayed value of dynamic positioning current/sea force, the dynamic positioning system and the true current/tidal stream value
- describing the use of external force reference systems, including hawser tension, plough cable tension and pipe tension monitoring
- determining the sources of error and inaccuracy associated with differential global navigation satellite system (DGNSS)
- identifying and explaining the function of control computers, input/output (I/O) devices, network connections and operator stations
- identifying the quality of available data to an operator associated with DGNSS
- outlining advantages and disadvantages of the taut wire position referencing systems
- outlining advantages and limitations of DGNSS, laser-based position referencing system and frequency-modulated continuous wave (FMCW) radar-based position referencing system
- outlining the different types of position referencing systems used in dynamic positioning installations
- outlining the operational advantages and limitations of the Artemis position referencing system.

Knowledge Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements and performance criteria and include knowledge of:

- control system – computers/control elements/networks and man/machine interface (MMI), including:
 - achieving redundancy as described in International Maritime Organization (IMO) MSC Circ. 645 / 1580 and vessel FMEAs

- architecture of a typical dynamic positioning control system
- function of the following components:
 - control computers
 - I/O devices
 - network connections
 - operator stations
- dynamic positioning sensors - environment and vessel – anemometers/gyro/motion reference unit (MRU), including:
 - function of gyro compasses and their redundancy within a dynamic positioning system
 - obtaining pitch, roll and heave information for input into a dynamic positioning system
 - reason for inputting pitch, roll and heave into a dynamic positioning system
- environmental reference systems, including:
 - limitations of wind sensor inputs
 - reasons for and the consequences of deselecting wind sensor inputs
 - method by which the dynamic positioning system determines the value for dynamic positioning current or sea force (the residual error resulting from unmeasured errors and unmeasured forces acting on the vessel)
 - provision of wind sensors within the dynamic positioning system
 - reasons for discrepancy between the displayed value of dynamic positioning current (or sea force) on the dynamic positioning system and the true current or tidal stream value
 - wind feed-forward facility and its importance within the dynamic positioning system
- external force reference systems, including:
 - the use of external force reference systems such as hawser tension, plough cable tension and pipe tension monitoring
- global navigation satellite system (GNSS), including:
 - advantages and limitations of the DGNSS when compared with other position referencing systems
 - available quality data associated with the DGNSS
 - error and inaccuracy associated with the DGNSS, describing the effects on the quality of positioning.
 - operation of a typical commercial DGNSS network where corrections are delivered by satellite communications
 - principles of the DGNSS
 - principles used in relative DGNSS
- position referencing systems, including:
 - different types of position reference systems used in dynamic positioning installations
 - different principals used in the operation of the above systems, including:
 - GNSS, including:
 - advantages and limitations of the DGNSS when compared with other position

- referencing systems
 - available quality data associated with the DGNSS
 - error and inaccuracy associated with the DGNSS and the effects on the quality of positioning
 - operation of a typical commercial DGNSS network where corrections are delivered by satellite communications
 - principles of the DGNSS
 - principles used in relative DGNSS
- laser systems, including:
 - advantages and limitations associated with a laser-based position referencing system
 - method of setting up a laser system to provide best position information
 - principles of position references using laser-based systems
- FMCW radar-based systems, including:
 - advantages and limitations associated with FMCW radar-based position referencing systems
 - operational advantages and limitations of the Artemis position referencing system
 - principle and operation of the Artemis position referencing system principles of position reference using FMCW radar-based systems
- acoustic systems, including:
 - layout of a typical hydro-acoustic system, including operator station, transceiver, transducer pole and transducer
 - operation of hydro-acoustic position referencing systems
 - operational advantages and limitations of acoustic systems as a position reference for dynamic positioning
 - principles of position-fixing using underwater acoustic systems working in super-short baseline (SSBL)/ultra-short baseline (USBL) and long baseline (LBL) modes
 - various types of hydro-acoustic beacon: transponder, responder and pinger/beacon
- other systems, including:
 - advantages and limitations of the taut wire position reference systems
 - different types of taut wire position reference system
 - display of taut wire reference data in the dynamic positioning system
 - principle of position reference using the taut wire system.
 - principle of inertial navigation system (INS) and the methods of using INS to enhance existing position referencing system performance
 - other position referencing systems that may be used in conjunction with a dynamic positioning system
- position reference handling, including:
 - median rejection when three or more are used and the importance of monitoring the position reference page
 - relative accuracy and reliability of position referencing systems, together with the

- methods used to apply weighting and pooling and voting when more than one position referencing system is used
- power development and power distribution, including:
 - functions of a power management system as installed on Class 2 and Class 3 dynamic positioning vessels
 - power generation and distribution arrangements in a typical diesel-electric dynamic positioning vessel, with particular reference to system redundancy as described in IMO MSC Circ. 645 and vessel FMEA
 - power requirements of dynamic positioning vessels and the concept of available power and spinning reserve in worst case failure
 - power supply and distribution arrangements in a typical hybrid diesel/diesel-electric dynamic positioning vessel (main controllable pitch propellers (CPP) or Az drive which are direct drive)
 - provision of uninterruptible power supply (UPS) to the dynamic positioning system, with particular reference to power shortages, failures and system redundancy
 - propulsion systems, including:
 - azimuth thrusters
 - azipod thrusters
 - importance of monitoring the displayed values of set point and feedback data for thruster and propeller rpm, pitch and/or azimuth
 - operational characteristics and common failure modes of the different types of propulsion systems as described above
 - rudders
 - tunnel thrusters:
 - Voith Schneider
 - waterjet
 - types of propulsion system commonly installed in dynamic positioning equipped vessels, including main propellers.

Assessment Conditions

Assessors must hold credentials specified within the Standards for Registered Training Organisations current at the time of assessment.

Assessment must satisfy the Principles of Assessment and Rules of Evidence and all regulatory requirements included within the Standards for Registered Training Organisations current at the time of assessment.

Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.

Assessment must occur in workplace operational situations where it is appropriate to do so; where this is not appropriate, assessment must occur in simulated workplace operational situations that replicate workplace conditions.

Resources for assessment must include access to:

- applicable documentation, such as legislation, regulations, codes of practice, workplace procedures and operational manuals
- tools, equipment, machinery, materials and relevant personal protective equipment (PPE) currently used in industry.

Links

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