DP Maintenance Course

The following detailed course outline has been developed in learning objectives:

Brief history of DP system development

- Development of DP Systems and what is needed for offshore drilling
- Brief discussion on the way DP is used

Reasons why DP is used extensively; Client requirements; Safety etc.

- DP can be used when water is too deep for Anchors
- Removes the need to make fast to offshore installation and improves the safety for crews
- Quick deployment at a new location of any type of vessel
- Increasingly difficult to manually operate multi-thruster vessels
- Provides a stable platform for crane ops, gangway ops, ROV ops etc.

Types of DP Vessels

- Course to briefly discuss the type of DP vessels and their use. OSV, drilling units, construction vessels, dive vessels, pipe lay vessels, wind farm vessel, passenger vessels. Describe type of thrusters fitted

Theory of DP control; Explanation of how the system positions the vessel; Heading; Feedback; Wind; Modelling, Kalman filter, controllers and DP current etc.

- To be able to discuss briefly the main elements of a DP System, DP Computer/Controller, Thruster and propulsion, Power systems, position reference and environmental sensors
- Describe why the DP system requires a wind input
- Describe why the DP system requires a heading input
- Describe why the DP system requires an input for roll, pitch and possibly heave
- Describe full Joystick mode
- Describe joystick auto heading mode
- Describe 2 axis control
- Describe full 3 axis control
- Describe the difference between DP Joystick and remote joystick and independent Joystick
- Describe modelling
- Describe the function of Kalman filters
- Describe how DP current is calculated

DP equipment classes as defined in IMO guidelines and Classification Society rules.

- Describe Class 1, Class 2 and Class 3 DP vessels
- Describe enhanced notation.
- Review DP system generic one line drawing for Class 1, 2 and 3 vessels
- Describe redundancy
- Describe Worst Case Failure (WCF) in terms of redundancy
- Describe Loss of redundancy effecting class of the vessel
- Describe the overuse of power and the effect on WCF redundancy
- Describe what class of vessel is best suited for each industry mission
- Describe consequence analysis alarm and requirement for the use during class 2 and 3 operation
- Describe what would trigger a consequence analysis alarm

Typical elements of a generic DP system

- Describe the function of Controllers
- Describe the function Serial input
- Describe the function Analog and digital input and output
- Describe the function Network system
- Describe the function power Supplies

The Power System

All components and systems necessary to supply the DP system with power. The power system includes:

Fuel systems

- Describe a generic redundancy fuel system
- Describe potential failures and associated impact on DP Class
- Describe how contaminated fuel can affect redundancy
- Describe how the cross connection of a fuel system will defeat redundancy
- Describe the effects of inadvertent operation of fuel tank Quick Closing Valves.

Cooling systems, Fresh and Sea Water

- Describe a generic redundant cooling system for fresh and sea water
- Describe the impact of system failures on DP Class
- Describe cooling pipework separation required for class 3 redundancy
- Describe the requirement to keep plate coolers, sea strainers clean and the effects of overheating. Overheating will be leading to a reduction of power available and effect on redundancy.
- Describe the use of two sea suction valves in a system
- Describe the effect of weed and jelly fish blocking sea suctions
- Describe the effect of ballast pump if connected to the same sea water system suction as the cooling system.
- Describe the use of antifouling system requirements in sea water systems.

Compressed Air System

- Describe the layout of a typical redundant compressed air system
- Describe the possible effects of compressed air failure on DP operations
- Describe precaution with sharing ships compressed air with on deck Industry mission

equipment

Ventilation system

- Describe layout of a redundant engine room ventilation system
- Describe the possible effects of inadvertent closure of ventilation dampers during DP operation
- Describe possible effects of gas detection and fire detection equipment could have on ventilation systems.

HVAC

- Describe layout of HVAC systems for redundant equipment operation
- Describe the effect of loss of HVAC to Engine rooms, Equipment rooms, switchboard rooms, control rooms and bridge could have on the DP system

Lubrication system

- Describe a typical layout of a redundant lubrication system for an engine
- Describe a typical layout of a redundant lubrication system for propulsion system
- Describe the important of a pre lubrication system on a standby generator engine to allow quick start up.
- Describe the consequence of loss of lubrication system for thrusters, CPPs and gearboxes
- Describe the importance of Oil sampling and testing as part of the maintenance routines

Generators and Main Engines

Main engines

- Describe typical generation plant layout redundant power generation arrangements. Both full diesel electric and direct drive main thrusters

Main Switchboard

- Discuss the generated voltage options and limitations with regard to main switchboard short circuit design.
- Describe a typical layout and functionality of a redundant switchboard for a diesel electric power plant
- Describe interlocks on main switchboards
- Describe potential failures and the impact on DP Class
- Describe switchboard protection systems
- Describe the term “designed to test”
- Describe problem with main switchboard, under and over voltage, under and over cycles, short circuits.
- Discuss the precautions to be taken before re-closing a bus tie or main breaker after a trip
- Describe why you would have thermal imaging conducted on switchboards on DP vessels
- Describe the function of automatic change-over systems
- Discuss the problems with connecting mission equipment to a redundant main switchboard.
- Discuss DC main switchboard concepts
- Discuss monitoring equipment on main switchboard
- Discuss Energy Storage system. Connections with switchboards. Max power usage, Battery safety

Generators

- Describe typical arrangements on a DP2 vessel
- Describe Spinning reserve and power available
- Discuss the arrangements required to ensure redundancy remains in place and what factors influence redundancy
- Describe the use of standby generators and at what load should generator auto start
- Describe spinning reserve and power available
- Describe the reason to disable auto stop on low load when on DP
- Describe how the use of more than 45% utilization can affect redundancy
- Describe how the electrical power available will affect thruster output
- Describe how the electrical power available will affect the vessel capability plot
- Describe load shedding
- Be able to discuss a one-line electrical drawing
- Describe how generator monitoring systems are different to power management systems
- Describe AVR control base principal and result of AVR failure
- Describe the typical plant layout for a diesel electric DP vessel, compare the layout to a conventional vessel with twin CPP propellers. Discuss the advantages and disadvantages of both systems.
- Describe Engine shutdown and protection systems.

Bus-tie requirements of IMO/Class/ FMEA

- Describe open and closed bus tie as per IMO 645 / IMO 1580

- Discuss the precautions to be taken before re-closing a bus tie or main breaker after a trip

- Describe how open bus tie can ensure a fault on one switchboard will not affect another switchboard

- Describe with an example how the main bus-tie breaker and all other breaker are setup as per FMEA

- Describe benefit of closed bus tie systems

- Describe that after WCF on a closed bus tie system the bus tie is to remain open if trip during WCF until fault is found.

- Describe breaker selective study, fault ride through and that the main bus tie is to open before the generator breakers.

- Discuss new requirements for testing of bus tie breakers

Electrical Systems and Cabling Communications

UPS

- Describe a typical UPS arrangement for DP2 and 3 operations
- Describe the function of an Uninterrupted Power Supply
- Describe how to operate the bypass of a UPS
- Describe test requirements for a UPS
- Describe typical alarms from a UPS
- Describe maintenance and life of UPS batteries

AC supplies

- Identify on a one line drawing the redundancy setup and ensure there is no cross connections
- Identify what is connected to the AC circuits and possible loads
- Describe a typical one line diagram for distribution and supply of AC circuits on a DP vessel
- Identify what is connected to the AC circuits and which are critical to DP operations.
- Describe all sub tie breakers need to stay open regardless if the main tie breaker is open or closed
- Discuss circuit protection and fuses
- Discuss testing of auto standby circuits for pumps, steering etc.

DC supplies

- Describe a typical 24v DC Redundant supply one line diagram
- Describe the various arrangements for backup supplies to engine control systems and switchboards
- Describe the risk of cross connections 24v supplies
- Describe the problem of earth faults on two redundant systems and the use of DC/DC isolated supplies
- Discuss the importance of clearing DC earth faults promptly for safe operation
- Describe procedures for testing and maintenance of battery backup systems
- Describe what could happen if there is a loss of charging power
- Describe typical alarms from 24v DC systems

Digital interface

- Describe a typical digital interface arrangement to a DP controller
- Describe why a digital input is required by a DP controller and what system inputs normally use this type of input
- Describe how a digital signal may be transmitted over a network from a remote I/O station
- Discuss fail safe modes for digital signals and networks
- Describe the loss of redundancy upon failure of one multi-channel interface unit (I/O) with input connected signal from two different redundancy groups
- Discuss testing of digital signals

Analogue interface

- Describe the different analogue signals associated with DP control systems and their use
- Describe the benefit of 4 to 20 mA signals for control and feedback of thrusters and main drives
- Discuss testing of analogue signals

Serial interface

- Describe the concept of serial data transmission and its use in DP control systems
- Describe the various types of serial connections, RS232 & RS422
- Describe the different types of NMEA protocol sentence formats and how to read them
- Describe how to monitor NMEA string using the DP display, laptop OR meter
- Describe a simple check for NMEA string data errors
- Describe the benefit of using RS422 serial connections over RS232
- Discuss serial isolators and serial signal convertors
- Discuss cable requirements for interconnection of serial units
- Discuss / show examples on different NMEA strings (i.e. GNSS, wind, gyro etc.)

- Describe the purpose and use of optical isolator units

Network Systems

- Network layout for DP system
- Network storm
- Network testing

Power Management System custom systems and IMO DP equipment class 2/3 requirements

- Maintaining continuity of electrical power under all defined load and failure conditions
- General system functions
- Describe typical power management systems for a DP vessel
- Describe why a breaker selective study is required and the importance.
- Describe the difference between DP power limiting and Generator power management
- Describe the reason to disable load dependent stop while in DP mode
- Describe a generator monitoring system and the important information supplied.

Extra loads on switchboard with different operation, Drilling, ROV etc.

- Describe the need for a new load balance study when connect extra equipment. i.e. ROV26.2
- Describe the possible reduced power to thrusters
- Describe the possible effect on the vessels Capability plot
- Describe the problem of only supply from one switchboard and the loss of the switchboard
- Describe the possible of transferring fault and completes after failure of a piece of industrial equipment
- Describe what a load balance study is
- Describe what the term “designed to test” means
- Describe auto blackout recovery
- Describe load dependent start and the fact that the vessel could be passed the WCF load before extra generator start.
- Discuss why there may be different parameters in the PMS for DP operation and Sea Mode.
- Discuss system failures that can affect the operation of the PMS and backup operating modes that are available.
- Discuss advanced generator supervisory systems and their independent operation from the PMS.
- Extra redundancy required for working “drift off”
- Describe allow more spinning reserve when working drift on.

Cabling

- Describe the need to keep cables away from heat, exhaust flow
- Describe the physical cable routing for Class 3 vessels as per IMO 645 / 1580 and Classification Society requirements.
- Describe the importance of separation between power cables and control and data cables.
- Discuss use of separate cable trays and physical routing to maintain redundancy.
- Describe the use and grounding arrangements for screened signal cables.
- Describe the problem of replacing cables with the wrong type, not twist pairs
- Describe the problem of network cable near radio transmitters
- Discuss the use of fiber optic cable and its advantages over conventional types

The Thruster System

- All components and systems necessary to supply the DP system with thrust force and direction. The thruster system includes:
- Azimuth thrusters, Tunnel thrusters, Propellers and other systems

Thruster Control Concepts

- Describe how a DP system typically is connected to a thruster control system, including normal control and back-up control (on thruster control system).
- How will emergency operation of thrusters affect the DP control of the thrusters?

Thruster redundancy

- Thruster supply change over
- Describe how changing over a thruster that has failed could transfer the fault to a second redundancy group

Thruster failure modes

- Describe “Fail as set”
- Describe “Fail to zero”
- Describe “Fail to full”
- Describe why you would lose the ready signal.
- Describe that emergency stops will still work when vessel is in DP control
- Effect on the DP system of a failed thruster
- Describe the counterbalance effect of other thrusters when a thruster fails and the vessel is left in
full auto DP mode
- Describe thruster control by IP over Ethernet controlled and trouble shooting

Azimuth thrusters, Tunnel thrusters, Propellers and other systems

- Describe standard fixed pitch propeller advantages and disadvantages.
- Describe standard CPP advantages and disadvantages.
- Describe tunnel thruster advantages and disadvantages.
- Describe Drop down and fixed in position azimuth thruster.
- Describe fixed pitch thruster’s advantages and disadvantages
- Describe CPP Az thruster advantages and disadvantages.
- Describe flap / Becker rudders and advantages and disadvantages.
- Describe fishtail rudders and their advantages and disadvantages.
- Describe propeller nozzles advantages and disadvantages
- Describe Variable frequency drives and advantages and disadvantages.
- Describe Direct drive and advantages and disadvantages.
- Describe constant speed RPM motors for CPP thrusters and advantages and disadvantages.

Thruster Control Concepts

- All components and systems necessary to supply the DP system with thrust force and direction. The thruster system includes:
- Describe the thruster ready signal and what parameters are required for it to be present.
- Describe auto start-up of thrusters and auto selection into the DP system if a full blackout auto
recovery system fitted. Recovery system is programmed into the power management system.
- Describe command and feedback signals (mA and V) and which one is better,
- Describe emergency stop on thruster.
- Describe wire break monitoring.

- Describe remote I/O concepts used in thruster control network or can bus systems.
- Describe backup redundancy on control systems.
- Describe typical alarms on thruster controls and DP systems.
- Describe testing of thruster signals for DP trials.

Thruster redundancy

- Describe typical thruster main power supply systems for redundancy
- Describe typical backup hydraulic pumps, steering motors, cooling pumps, filters, cooling systems and fans fitted to rudder and thruster systems.

Thruster failure modes

- Describe what would indicate the following on a DP system Fail as set, fail to zero, fail to full, loss
of ready signal.
- Describe at hydraulic problem with CPP thrusters.
- Describe a thruster could always have a mechanical problem.

Control Systems and Sensors

- All control components and systems, hardware and software necessary to dynamically position the
vessel. The DP control system consists of the following:

DP operator workstation

- Describe a typical operator workstation and the various hardware components.
- Describe the management for change for software
- Describe the DP system must be full tested to check operation after software upgrade
- Describe typical maintenance and testing that should be carried out on workstation
- Describe a typical procedure for total shut down and re-starting of a DP control system
- Discuss ability to download log files for analysis

Control processor(s)

- Describe the function of the control processor in the DP control system
- Describe the redundant design incorporated into the control system
- Describe the redundant interconnections between the control processor and the I/O units
- Describe how a failure on a DP controller is typically handled to maintain position-keeping
- Describe how some DP systems use a PLC as part of the control system

Independent joystick system (IJS)

- Describe why IJS is needed
- Describe the difference between IJS and portable / wing joysticks
- Describe the class requirement for IJS
- Describe that some older vessel the IJS can use the same controllers
- Describe how a IJS is powered
- Describe which DP sensors and references are also typically used for the IJS

Peripherals

Printer

- Describe the DP printer and requirements for it to be online during DP operations
- Discuss DP Data Loggers as independent to the DP system, can replace as long as you can print
alarms.
- Discuss ability to download log files for analysis

Change-over switch, manual controls/DP/joystick

- Describe the design of a typical changeover switch as a multi-gang switch on a single operating spindle and are not electrical connected
- Describe that a common changeover switch removes the ready signal from the thruster to DP
system
- Describe the changeover switch in a Network thruster control system
- Describe emergency to manual on a network control system
- Describe wire break monitoring on emergency change over DP to manual and on a DP to Manual
network control system.
- Describe that the emergency stop and backup/emergency controls will still work with changeover
switch set to manual or DP mode or IJS Mode

DP Software

- Describe the six degrees of freedom and which of these the DP system controls
- Describe hydrodynamic model
- Describe aeronautical model
- Describe DP mathematical model and PID control loop
- Describe DP current
- Describe error affecting the DP current
- Describe reason for the mathematical model to become unstable
- Describe auto swap on the operator station and controllers. And class rules about swapping
- Describe DP modes
- Describe backup copy and reloading program under instructions for manufactures.

Alarms

- Describe the need to set alarms to activate to warn at any early stage
- Describe that the DPO and engineer must understand what the alarm is and what caused the alarm
- Describe how to find information about an alarm in vessels documents and on-screen help

Position Reference Systems; Hardware Software and Sensors

- Describe why position reference systems are used by the DP program
- Describe the minimum number of position reference systems required to meet class 1, 2 and 3
- Describe position reference system voting
- Describe the difference between “Fixed” and “Mobile” relative position reference system
- Describe what happens when all position reference systems are lost from the DP system

DGPS/DGNSS

- Describe principle of GNSS systems
- Describe DGNSS and the use of correction to improve the quality of position fix
- Describe the different way DGNSS corrections are received
- Describe the disadvantages of DGNSS system
- Describe the advantages of DGNSS system
- Describe the use of INS to improve the reliability of position
- Describe how to identify an antenna problem
- Describe the blocking of correction signal
- Describe the Azimuth and elevation of a corrections satellite
- Describe failure modes
- Describe maintenance and logical fault finding
- Describe Jamming and spoofing of DGNSS system

Acoustic

- Describe principle of an acoustic system.
- Describe why the speed of sound through the water is required
- Describe advantages
- Describe disadvantages
- Describe failure modes
- Describe maintenance and logical fault finding
- Discuss transponder types and use, charging of transponders

Taut wire

- Describe principle of a Taut wire system
- Describe advantages
- Describe disadvantages
- Describe failure modes
- Describe maintenance and logical fault finding

Laser - System

- Describe principle of a CyScan system
- Describe advantages
- Describe disadvantages
- Describe failure modes
- Describe maintenance and logical fault finding
- Describe the different types of laser targets, use and maintenance
- Describe CyScan AS targets
- Describe SceneScan targetless laser system

Microwave - Systems short and long range

- Describe principle of a RadaScan, Radius, Artemis system
- Describe the positioning of Interrogator units
- Describe advantages
- Describe disadvantages
- Describe failure modes
- Describe maintenance and logical fault finding
- Describe transponders and battery maintenance requirements

Inertial Navigation Systems

- Describe principle of INS Inertial Navigation system
- Describe advantages
- Describe disadvantages

- Describe how INS is used with DGNSS and hydro acoustic systems.
- Describe failure modes
- Describe maintenance and logical fault finding

DP Sensor Systems

Gyro

- Describe the principle of a standard gyro compass
- Describe the principle of a fiber optic Gyro compass
- Describe failure modes
- Describe why a Gyro might need to be set to manual speed and latitude
- Describe maintenance and logical fault finding

Environment Sensors - MRU/VRU

- Describe the principle of a VRS/VRU
- Describe why a DP system needs a MRU/VRS input
- Describe failure modes
- Describe maintenance logical fault finding and calibration required
- Describe that some MRU/VRS have internal batteries

Environment Sensors - Wind Sensor

- Describe principle of propeller and ultrasonic wind sensors.
- Describe wind feed forward
- Describe the effect on DP from wind sensor outputting a too high speed and effect on Model
- Describe the effect on DP from wind senor outputting a too low speed and effects on DP model.
- Describe advantages and disadvantages of sensor types
- Describe maintenance and logical fault finding
- Describe simple checks, flags,
- Describe problem with the poor positioning of wind sensors.

Documentation

DP Manual

- Describe every DP vessel must have DP Manual which outline DP Operations, Company DP policy, onboard documents, training and vessel hardware. Some Classifications require the DP Manual to be class reviewed

FMEA

- Describe what FMEA stand for
- Describe why an FMEA is required and the legislation associated with FMEA
- Describe what is contain in the two main section of an FMEA
- Describe the content of the vessel study
- Describe the process of developing an FMEA and the international guidelines that are recommended
- Describe the overall contents of the proving trials section
- Describe the meaning of A, B and C findings
- Describe the requirement for FMEA to be Class approved
- Describe what WCFDI worst case failure is and why is it important
- Describe how to conduct FMEA trials safely
- Describe why a copy of the FMEA must be in the engine room and control room

- Study of an actual Vessel FMEA to illustrate the process of redundant system review
- Describe action to take if errors are found in FMEA
- Describe the use of FMEA functional description and block diagrams for fault finding and tracing of faults.

DP Annual Trials

- Annual Trials as per IMO 1580 and IMCA M 190
- Describe CPP and thruster wire breaks need to be tested every year
- Describe that the redundancy group are to be tested each year

Capability Plots

- Describe what a capability plot is
- Describe capability plot for WCF
- Describe the difference between a capability plot and a foot print plot
- Describe why a foot print plot cannot be used to check a capability plot
- Describe the errors that can occur within Capability plots
- Describe how to use max thruster limit of 45% utilization to safe guard against error in Capability plots
- Describe online capability plot
- Describe why reducing the number of generators and power available can affect the capability plot

Management of Change Procedures

- Describe what is meant by Management of change
- Describe why Management of change is important
- Describe what management of change is required for changes of Hardware, software, FMEA

System and Equipment Manuals

- Discuss the importance of having a full set operating and maintenance manuals for all DP related systems.
- Discuss the importance of having a full set of up to date “as build” technical drawings for the vessel
- Discuss the use and development of bridge and engine room DP checklists.

Hazards

- Describe the importance of not carrying out unauthorized maintenance during any DP operation and permit to work.
- Describe Managing risk during reinstatement of equipment

Incident Reporting - IMCA and MTS schemes

- Discuss incident reporting forms for IMCA and MTS.
- Discuss recent and relevant incident reports.

Planned Maintenance System

- Discuss the importance of an effective planned preventative maintenance system for all machinery
and equipment related to DP.
- Discuss the importance of maintaining good record keeping and equipment histories.
- Discuss the importance of record keeping of service reports and technical bulletins relating to the DP equipment.
- Describe the process and responsibilities of planning maintenance activities which may

affect DP operations.
- Discuss the requirements to carry critical spares for all DP equipment

IMO Documents

- Describe IMO 645 and IMO 1580
- Describe IMO 738 and links to IMCA 117

OCIMF - Oil Companies International Marine Forum

68.1 DP Failure Mode Effects Analysis Assurance Framework Risk Based Guidance

Use of IMO 645 / 1580 by Class, IMCA and MTS

69.1 Discuss Class use of IMO 645 / 1580 and IMCA/MTS documents to formulate Class rules.

MTS Documents available and what they contain MTS Design Philosophy

- Offshore Tech. Guidance DP- classed vessels with closed bus-tie(s)
- DP Vessel Design Philosophy Guidance Part 1
- DP Vessel Design Philosophy Guidance Part 2
- MTS DP Operation Guidance
- DPGuidance_Part2_Appendix3_Logistics
- DP Guidelines on Testing of DP Systems
- DP Tech Committee DP Operations Guidance_part1
- MTS tech ops
- Techop Annual DP Trials and Gap Analysis
- Techop FMEA Gap Analysis
- Techop FMEA Testing
- Cross Connections
- All other tech ops

IMCA Documents available and what they contain

- IMCA M103-The design & Operation of DP vessels
- IMCA M109-DP Related Documentation for DP vessels
- IMCA M117-Guidelines for the training & experienced of key DP personnel _September 2016
- IMCA M125-Safety Interface Document for a DP vessel working near an Offshore Platform
- IMCA M140-Specification for DP Capability Plot
- IMCA M163-Guidelines for Quality Assurance & quality control of software
- IMCA M166-Guidance on Failure Modes and Effects Analysis (FMEA)
- IMCA M182-MSF International Guidelines for the Safe Operation of DP OSV
- IMCA M190-Guidance for Developing and Conducting DP Annual Trials programmes
- IMCA M206-A guide to DP electrical power and control systems
- IMCA M220-Guidance on Operational Activity Planning
- IMCA M244-Guidance on vessel USBL systems for use in offshore survey, positioning and DP
operations
- IMCA M247-Identify DP System Components and their Failure Modes
- IMCA M252-Guidance on position reference systems and sensors for DP operations

Manning, Training and DP Emergency drills

- Describe engine room manning and watch-keeping principals for DP operations
- Describe requirements for good communication between bridge and engine room at all times
- Describe the use of checklists and need to promptly report to Bridge of any changes in operational status
- Describe the need to keep the Chief Engineer updated with any operational problems
- Describe the operation of the status alert system
- Describe the requirement for comprehensive engine room standing orders
- Describe the requirement for a comprehensive handover during change of watch-keepers
- Describe the Planning of on-board drills, real and desktop
- Describe the use of "Mobilization" and "start of project" DP trials to ensure system operational readiness
- Describe the development of standard engine room DP procedures for vessel
- Describe the need for performing DP drills and their different types
- Describe how to conduct a Partial blackout drill.
- Describe how to conduct Outline a full blackout drill.
- Describe how to conduct Outline a drill for a broken fuel line.
- Describe how to conduct a drill for a broken cooling pipe.
- Describe how to conduct a fire drill when on DP.

DP Operation and effects on DP system

ASOG Principle, layout and use of Activity Specific Operational Guidelines

- Describe IMCA 220 and MTS Tech Ops documents outline ASOG in detail
- Describe ASOG list how the vessel equipment is setup for the current industry mission
- Describe ASOG should match the FMEA
- Describe ASOG will state what action to take after a failure
- Describe ASOG needs to be approved by Charterer, shore management and vessel
- Describe how the ASOG will be use as a decision-making tool after a failure
- Describe the ASOG is used for the safe setup of DP vessel
- Describe the ASOG is the bridging document between the vessel and charterer and layout how the

DPO must have their vessel setup and operational limits

- Describe the alignment of alert light system and ASOG
- Describe how the ASOG/CAM is used to reduce risk
- Describe the CAMO must match class approved FMEA
- Describe the use of "status light" system on DP vessel
- Describe the ASOG/CAMO is a bridge document between vessel documentation and charterer working limits and equipment setup requirements.

CAMO Principle and layout of Critical Activity Mode of operation

- Describe IMCA 220 and MTS Tech Ops documents outline CAMO in detail
- Describe that CAMO mode set is setup as redundancy mode of operation
- Describe how the CAMO must match the vessel FMEA

TAM Principle and layout of Task Appropriate Mode

- Describe IMCA 220 and MTS Tech Ops documents outline TAM in detail
- Describe that TAM requirement could be less than required by the FMEA and after a failure the

vessel could have a loss of position

- Describe TAM can be used to reduce fuel when the loss of position would not affect safety

of vessel.

TAGOS Principle and layout of Thruster and Generator Operating Strategy

- Describe how the TAGOS can be used to list what combination of generators can be online, setting
of all tie breakers and maximum percentage of load used.
- Describe the TAGOS arrangements
- Limitations of different type of DP operations
- Describe the mode of operation will depend on the modes supplied with DP system
- Describe the reason DP vessel cannot be used for anchor handling without tow winch tension meter
is feed into DP and the problem if tension meter fails.

SIMOPS

- Describe Limitations and extra redundancy required when vessel is in Close proximity and drift on.
- Describe that extra redundancy and generators may be requested by DPO in a high-risk drift on.
- Describe at times the main watch-keeping engineer might need to stay in the control room
- Describe how vessel can be affected by thruster wash from other vessels
- Describe how working in close proximity to other vessels might limit the options for maneuvering the vessel in event of a failure.
- Operating in open water
- Describe how in open water the vessel (ROV / Bell) might be "drift on" to a subsea asset.
- Describe which position reference system will not work
- Possible effects of subsea operation on DP vessels.
- Underwater current on drilling risers, Lars, tether and ROV leading force on DP
- Launch and recovery high risk operation
- Danger of tether becoming entangled in thrusters

Possible effects of remote access

- Describe using Remote diagnostics and the danger of use during DP
- Describe the damage of cross connecting network system and cyber attack

Lessons Learned

- Common causes of DP incidents (past incident case studies)
- Review IMCA DP incident flowcharts
- Review of various published Incident report. (IMCA, MTS, Coastguard)

Information required when reporting system problems

- Remote diagnostics
what information is required, where to find and how to communicate.
- Describe common methods of copying system log files from operator station computer for fault analysis by equipment maker.
- Describe the use of screen shots and photos of the equipment to aid fault finding. Also copies of the alarm printouts of both DP and machinery alarms when fault occurred.
- Discuss the importance of maintaining records of correspondence of any fault with the equipment
luding in all relevant company technical and operations departments.
- Discuss the trend in remote access via satellite link of some equipment makers. Highlight the
security risks of this type of arrangement